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SAMUEL RALPH POWERS, *Administrative Officer*

CONSIDER THE CALENDAR

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TO

PROFESSOR CLYDE R. MILLER

WHO PRACTICES WHAT HE TEACHES

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CONSIDER THE CALENDAR

CHAPTER I

THE CALENDAR IN PERSPECTIVE

"To everything there is a season, and a time to every purpose under the heaven: . . . a time to plant, and a time to pluck up that which is planted . . ."—ECCLESIASTES 3:1, 2

HISTORICAL OVERVIEW OF THE CALENDAR

FOR an understanding of a peculiarly social instrument like the calendar, which appears to dominate our lives, from day to day, a backward glance is necessary. But when such an instrument fails adequately to accord with our modern needs and knowledge, a historical review becomes imperative.

WHAT IS THE CALENDAR?

The primary purpose of a calendar is, of course, to measure time. As the clock measures the seconds, minutes, and hours, the calendar measures longer periods: day, week, month, and year. It is an instrument of reckoning which fixes the length and the divisions of the year into approximate twelfths, halves, and quarters in such a manner that the seasons appear at about the same date from year to year. It is a fairly approximate instrument for keeping track of the relationship of our planet to the sun and moon and the fluctuating seasons. As it now stands, it is like a clock which ticks off the days, weeks, months, years, and centuries. It is intimately related to all our religious, social, and economic affairs. Today practically everybody uses the calendar. We would feel lost without one. But in the days of its beginnings, only farmers needed it for the sake of their livelihood. Then priests took it into their safekeeping to ensure its efficacy, and pontiffs and kings used it later for their own political advantage and economic domination, as we shall see in the course of our considerations.

The word *calendar* is derived from the Roman word *calendae,* the name given to the first day of any month, a time which was determined by the visibility of the new moon. In ancient almanacs this word was written in large letters at the beginning of each month. *Calendae* is derived from the root word *calare,* meaning *to call* or *to proclaim.*

Among the ancient Romans, the chief priest (*Pontifex Maximus*) proclaimed a new month on the day the thin crescent of the moon appeared in the western sky. This custom was established by peoples of still earlier times—the Babylonians, Hebrews, Arabs, Chinese, Egyptians, and Hindus—who also used the *lunar month* and whose deities were lunar deities. And it was on this day, too, that the priests called out the days which were to be kept for sacred festivals during the month.

THE CALENDAR IN MODERN LIFE

In modern life the calendar is an important and essential instrument by which we arrange our activities from day to day, or from season to season. In fact, it is so important that many of us carry a small calendar for ready reference.

With the aid of the calendar, the housewife, shopkeeper, worker, industrialist, and government employee budget and measure their incomes, expenditures, and resources. Every mine owner, factory operator, and utility magnate envisions the future, and plans according to calendrical schedule for construction, operation, production, and extension in his industry. Without the calendar, statistical, actuarial, and fiscal calculations would lack meaning and validity for comparison.

For example, time is one of the basic units of the statistician; many statistics must relate to dates. The recording of the dates of births, marriages, and deaths is an evidence of the various fields in which exact data are needed.

Financial transactions are usually made for quarterly and semiannual periods. Taxes are usually paid at such intervals. Wages and insurance, expenditures and incomes, profits, losses, rents, dues—all are paid monthly, quarterly, or semi-annually.

Transportation schedules are planned by the calendar so that "peak loads" at holiday times may be cared for, week-end traffic accommodated, and daily commuting made smooth and easy.

Our educational system is dependent upon the calendar. Most city schools open the day after Labor Day—whenever that may be—and run for a specified number of weeks, giving ample consideration to holidays and conventions. Rural schools frequently must adapt their year to the seasonal crops of the community so that the children may help with the harvesting. Some schools in Florida close during the strawberry season; some in Maine are affected by the potato crop late in the fall; in Nebraska, in 1942, some schools closed for two weeks for the sugar-beet harvest, and often opened during August so as not to shorten the school year.

The calendar is essential to modern business. Purchases are made on a comparative basis: we will order so much this April because we sold so much last April. Easter and Christmas are times of peak buying. Yet a cold, early Easter may mean low March sales and high April sales, while a warm, early Easter may increase March and lower April purchases. On the other hand, a warm March and late Easter may mean early selling, governed by the weather, or may mean postponed sales, governed by the holiday. Therefore, the merchant cannot compare his sales of previous years and buy his stock according to earlier successes or failures; he must gamble on each year separately.

We must consult a calendar to ascertain the time of our national holidays. "On what date does Thanksgiving occur this year?" we ask. "On what day of the week is Christmas? Will the Fourth of July give us a long week-end?" Look at the calendar!

Our social life is subject to the dictates of the calendar.

A meets B at a Christmas party. "Let's plan to meet again during the Easter holidays."

"Let's see; when does Easter come this year? March or April? Oh, so late? Funny thing, this peregrinating Easter. Wonder why. Well, anyway, I might get down to meet you the Easter week-end. Maybe we could arrange to hear *Parsifal* together. Oh, the *date!* Let's have a look at that calendar again."

In another part of town, the chairman and secretary of a committee are talking. "Better not plan those meetings for the fifteenth of each month. Better say the 'second Wednesday' of each month. Then we can all be sure of a day that will stay put. No. Tuesday won't do; the X society meets then. And Monday is always bad after the Sunday let-down. Yes, Wednesday just about does the trick."

Modern warfare is planned with an eye on the calendar. Military campaigns cannot conveniently be started during the monsoons, or the heavy snows, or the big heats; they must be completed before these seasonal phenomena occur again. Supplies must be conveyed to prospective battlefields before certain harbors freeze over or before the routes are made hazardous by icebergs. During certain seasons in certain places, infantry alone is useful. The air wing cannot function at all during certain periods because fog and cloud impede the vision in locating military targets.

The calendar plays an important role in the logistics of war. It is within the perspective of the calendar that a military campaign is projected, planned, and prosecuted. In World War II the dramatic African campaign under General Eisenhower was obviously planned long in advance with a specific objective in view. We are told that the Soviet 1942–43 winter offensive against the highly synchronized Nazi army was planned by Marshal Stalin during the early summer of 1942, in anticipation of certain definite situations and objectives. And anticipation, in terms of the calendar, is the key on which the entire superstructure of strategy and tactics rests.

Even sports and recreation are governed by the calendar. Sports follow the seasons with considerable regularity. Football means that autumn has come. Basketball, skating, skiing, and ice hockey are symbols of winter. Hiking becomes popular with the advent of spring, while swimming, boating, and camping are synonyms for summer.

Thus, no matter what the enterprise or undertaking, whether in the interests of personal living or business achievement, or in the social and economic planning for a future world order, we cannot help considering the calendar. It is always with us, helping or dictating, as the case may be. The calendar is essential to our modern needs, just as it was to earliest historic man, and for the same fundamental reasons.

HOW THE CALENDAR CAME TO BE

We all speculate to some extent about how the heavenly bodies came into being, but few of us have wondered about the origins of the calendar—this device for reckoning the year—or have sought to find out how it came to be.

The calendar has been vital to man ever since he first settled on the land and began farming and tending herds. Unlike most instruments of his devising, the calendar cannot be made to fit human arbitrariness and plan. On the contrary, before he was able to make this instrument of his conform at all with the annual revolution of the earth around the sun and to fix the record of the recurrent seasons, man had, generation after generation, taxed to the utmost his ingenuity and patience for observing and remembering natural phenomena. Our calendar is one record of what he experienced.

Periodicity and recurrence in nature are the bases of all calendars.[1] From earliest days man has utilized some easily observable, repetitive phenomenon as a standard to measure the passage of time. At an early date he must have begun to divide time into day and night. He also must have recognized the gradations from sunrise through forenoon, noon, afternoon, sunset, dusk, and night.

As the centuries went by, different cultures began to use some salient celestial or local terrestrial phenomenon to guide them in marking the passage of time and of the seasons. In the sky were the moon, stars, and sun. The earliest heavenly bodies to excite man's interest were Sirius, the Pleiades, Orion, and the planets. As time passed, man came to associate their coming with propitiousness and used magical rites to ensure their perpetual recurrence. He proclaimed their arrival with ceremony. Did not Sirius appear at the time of the flooding of the Nile, a season of fruitfulness?

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[1] J. T. Shotwell, "The Discovery of Time." *Journal of Philosophy, Psychology, and Scientific Methods,* 12:197-206, April 15, 1915.

Very early, man must have learned to recognize characteristic seasonal attributes. The reviving warmth of spring brought sprouting, budding, blossoming, and the green flush of life back upon the earth, and indicated the time to begin agricultural activities. He noticed the migrations of birds, the emergence of animals from hibernations, and the noisy joys of the mating season. He observed and marked the march of frost in its colorful pageant, and the trek of man and beast in search of warmer climates and new pasture lands. He marked these recurrences and periodic renewals with sacrificial offerings, taboos, and ceremonials to ensure his life upon earth. In time, he recorded these events so that he might not be guilty of a fatal omission. These records became the calendar, a guide to daily action and religious service.

The calendar grew with man's increasing experience and came to be the temporal repository of mankind's cumulative pastoral, agricultural, religious, industrial, and explorative experiments; it holds a clue to the cultural frameworks in which these experiments had their origin. As time passed, and man grew stronger in his powers of reasoning, searching, and rationalizing, the calendar recorded the progress of his more objective scientific developments as well. Today the calendar in one form or another, in diverse cultures, still regulates man's daily life and synchronizes the rhythm of his activities with the seasons and with the cultural needs and functions of the society of which he is a part. Today we accept this man-made calendar of ours, with its monthly order, as we accept the celestial sequence out of which it originally developed.

The basic concept of the measurement of time is, in all probability, as old as man. However, refinements in time measurements have grown in terms of man's need, with the stage of development of his tools and techniques, and with the state of his culture. From prehistoric time to this day man has struggled—circumscribed, of course, by his understanding—to discover and formulate what we call the "laws of nature" to comply with his specific needs. Man's original teacher seems to have been his outer world; it continues to be a tantalizing mentor. Of all the forces in that world, the sun seems to have been the most powerful, the guide and director of his life.

The Original Measurer of Time: The Sun. From earliest times, man has sought to orient himself to time. No doubt our first ancestors were conscious of the sun's relationship to light and darkness and therefore designated what was probably the very first measure of time—day and night—a natural and obvious division.

Even the simplest forms of life respond to the influences of sunlight, as is manifested in phototropic and photosynthetic phenomena. Most of the birds begin to be active at dawn, proclaiming by their song or chatter the birth of a new day, and at dusk are beckoned to their roosts; later, the oncoming and all-pervading darkness lulls them to slumber and silence again. So it has been with man and other creatures from time immemorial. The light of approaching dawn, the rising sun, have meant that it is time to be up and doing, as surely as the setting sun and the succession of night have suggested rest and sleep.

But day and night recurred endlessly. Some larger cycle of grouping these periods of light and dark was needed. Although the seasonal changes in weather were some help, they were long and too far apart. Was there no other shorter division of time?

Measuring Time by the Moon. As the sun was the most conspicuous celestial body by day, so the moon dominated the heavens by night. Early man could not help noticing its "waxing and waning." He gradually recognized the fact that at certain intervals it could not be seen; later it appeared as a crescent, gradually "became" a half-moon, and finally "grew" into a brilliant silver disk, only to "die" and disappear again.

Each of these cycles of appearance encompassed a seemingly regular number of days. These days became a measurement of time, a "moonth," month as we call it. Many generations must have passed before primitive man determined the *exact* period from one new moon to the next, or from one full moon to the next succeeding one. Such a period is called a *lunation.* Astronomers specify it as a *synodic* month; laymen, as a *lunar* month. Early man must have formulated this period only after he had evolved a systematic device for reckoning and recording his information.

Practically *all* primitive peoples reckoned the passage of time by lunations. Anthropologists have found that among primitive people even today the lunations are related to their fundamental needs and furnish the customary unit of reckoning periods of time longer than a day. Pastoral people, too, calculated the time of the increases in their flocks and herds by lunations; that is, they counted the number of moons from breeding to foaling. Increases in his flocks and in his own family have always been factors in man's survival, and so he learned to mark the periods of gestation in relation to lunations. By correlating his needs with the lunations, he evolved the units of time. Even today there are country people and primitive groups who still preserve an earlier and fairly approximate measurement of nine lunations for reckoning the period of human gestations, from conception to birth.

Now we know that each phase of the moon approximates a week in duration. According to our present knowledge, a lunation (lunar month) averages about 29½ days (29.530588 solar days = 29 days, 12 hours, 44 minutes, and 2.8 seconds). Twelve lunar months constitute a lunar year, which amounts to approximately 354 solar days (or more exactly, 354.3671 = $354^d\ 8^h\ 48^m\ 34^s$).

Measuring Time by the Seasons. The next larger measure used in reckoning the passage of time was the season. It is presumed that seasons were recognized at the close of the pastoral stage or during the early part of the agricultural stage. Pastoral man, in search of grazing lands, moved from one region to another and, during his peregrinations, discovered the plants that furnish grains. He learned to cultivate these grains for food. And like his early ancestors who had observed the cycles of the moon, he became aware of the distinct rhythm and regularity of the seasons in the tropical lands that he inhabited. He observed the suitability of soil and climate to the growth and harvesting of the crops: the time of sprouting, the time of growth to maturity, and the time of no apparent growth and of sleep. Man saw these changes in the vegetation about him and in the lives of wild animals. Plants sprouted and animals bred; plants grew to the time of harvest and animals lived through the period of gestation to the birth of the young; plants turned to their autumn colors and died while the animal young grew to individual independence; then the trees stood bare, flowers and grass died, and animals crept into dark holes to sleep until waked by a warm sun and a sense of the fresh sprouting of green life. These periods became known as the seasons.

We usually speak of four seasons. Actually, the length and even the number vary with the altitude, latitude, and other geographic factors, but theoretically they are conceived to be astronomically set and defined for different localities. Thus in certain parts of India six seasons are observed, in Egypt three, in temperate zones four, and in the polar regions two. In order to have a stable agriculture, it was necessary that man be able to relate the changes in the sun's position to the changes in growth of the plant life and the seasons.

Two major requirements of agricultural man were a resplendent sun and a river valley of alluvial earth. The settlements of early agricultural man were along the banks made fertile by rivers —the Nile, the Euphrates and the Tigris, the Indus and the Ganges. Thus the development of the technique of production and the need of a systematic and stable agriculture led our farming ancestors in the fertile river valleys to discover the regularities of the seasons and to mark their progression. It is not surprising, therefore, that all agricultural peoples discovered, independently of one another, that seasons were distinct parts of an annual solar cycle. The correlation of these discoveries was vital to the evolution of an agricultural calendar. The concept of a calendar to record the season's changes took shape as a result of this primary agricultural need to keep a record of the time favorable for sowing, cultivating, and harvesting. Consequently, the calendar as we know it today, in its varying forms the world over, had its origin in man's utilitarian interest in feeding himself, his increasing flock, and his multiplying family with some degree of regularity.

Measuring Time by the Solar Year. Since that first step in calendar making, man has defined five basic time concepts for his different needs: the day, the week, the month, the seasons, and the year. Because of agricultural needs, the initial stage of calendar development focused on locating the seasons with precision. Hence the exact duration from one spring to another assumed supreme importance in the agrarian economy and came to be recognized as a year.

The largest calendrical unit has been called a year. The time required for one complete revolution of the earth around the sun, from one vernal equinox to another, or from one summer solstice to another, is known as a *tropical* or *solar* year.

The renowned Egyptologist Ludwig Borchardt (1863–1938) credits the Egyptians, more than six thousand years ago, with having first measured this interval as 365¼ days. Likewise, James Henry Breasted, the historian, observes that the early Egyptians invented and introduced the first "convenient and practical calendar" in the year 4236 B.C., and refers to this as "the earliest dated event in human history. It is important to remember also that this early Egyptian calendar, invented in the forty-third century B.C., is the very one which has descended to us. . . ."[2] The duration of the solar year, as determined with the aid of the most refined techniques known to science today, stands at present as 365.242216 days ($365^d\ 5^h\ 48^m\ 46^s$).

Different cultural and religious groups have considered the beginning of their years at different times. The Hebrew year begins with the coming of the new moon nearest the autumnal equinox and can occur on any day from September 6 to October 5. The Chinese year begins with the first new moon after the sun enters Aquarius, which is some time between January 21 and February 19. Those of us who follow the Gregorian Calendar—the one we use today—have a solar year that begins arbitrarily on January 1 (a date that was originally initiated on the first new moon after the winter solstice) and runs for 365 days in common years and 366 days in leap years. The variations and adjustments required under this last system will be considered later.

It is important to realize that one of the valuable contributions of our calendar has been the coordination of the season and the year so that certain natural phenomena fall with regularity on certain fixed dates. For example, in the northern hemisphere, the sun enters the vernal equinox (spring) on or about March 21; the summer solstice occurs around June 22; the autumnal equinox is close to September 23; and the winter solstice falls on or about December 22. And so man has correlated his agricultural needs with the solstices and equinoxes and arrived at the solar year.

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[2] James Henry Breasted, *Ancient Times*, pp. 58, 59. Second edition, revised. Ginn and Company, Boston, 1935.

Thus we see that geographical location, climate, animal and plant life, and the seasons—all of which affect human needs and culture—have been used to demarcate periods of time ranging from the day, month, and season to the solar year. All these factors in some form or other have been utilized in diverse calendars to serve man's needs in different parts of the world.

Introducing Our Own Calendar. Our present calendar, better identified as the Gregorian or New Style Calendar, has had a long history. It incorporates man's superstitions, as well as his basic experiences and scientific data, accumulated from different cultures and lands. It bears the imprint of man's attempts to synchronize his earthly enterprises with the movements of celestial bodies, and to regulate his religious and social activities according to a schedule which would ensure success to these earthly endeavors. It is the cumulative record of his early needs, of his taboos, of his evolving religious concepts, and of his efforts to understand his environment. Farmers, priests, scientists, and statesmen have had a share in creating it. It has been influenced by the Babylonians, Egyptians, Hebrews, Greeks, and Romans. It has been modified by astrology and astronomy. It has been the basic tool of every people from primitive man to the modern industrial worker. Yet it has remained unchanged from the year 1582 to this day, despite the tremendous advances in our sciences, in our manner of living, and in our lives and relationships to other humans. It is a lingering medieval instrument operating in a highly advanced and synchronized technological society.

ANALYSIS OF OUR CALENDRICAL INSTRUMENT

What is the effect of this medieval instrument upon our scientific modern society? Can it meet the demands of modern industry and business? Do its many subdivisions, accepted from an ancient past, aid or hinder negotiations in the twentieth century? How does it affect our international viewpoint? What will be its impact on the postwar world? Is it an instrument upon which we can rely with assurance?

IS IT AN ADEQUATE STANDARD?

Let us find the answers to these questions by beginning with the last one and asking, "Upon what kind of measuring instrument can one rely?" "What is a reliable standard?" "What is an adequate standard?"

A standard instrument is simple, exact, consistent, uniform, and practical. It is sharply defined; its beginning and its ending are distinctly indicated; and it is constant in its multiple parts. Any reliable standard records with precision the frequency of an occurrence and so facilitates easy calculations and reliable predictions.

Let us compare the foot rule as a standard with the common year. Even though the foot rule is not ideal, it will serve to illustrate the point. In Figure 1 the top scale indicates a foot rule and the bottom scale represents the common year with its units of monthly and daily divisions.

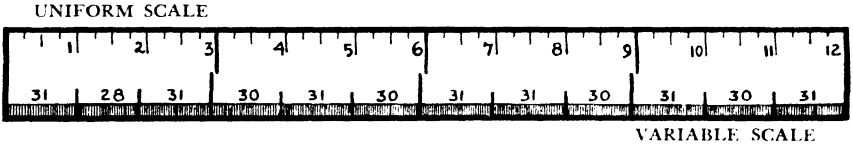

Figure 1. The Foot Rule and the Year

The foot rule is divided into twelve inches, and each inch is divided into four parts. Each inch is exactly 1/12 of the foot, and each small division is exactly ¼ of an inch, or 1/48 of a foot. The division into identical inches and quarter-inches creates a precise instrument of measurement which conforms to the requisites of a simple, exact, invariable, and functional standard. On the other hand, the scale for the year shows twelve monthly divisions composed of three distinctly varying lengths, namely, 31, 30, and 28 days each. Of these twelve divisions, seven are composed of 31 days each, four of 30 days each, and the remaining single division has 28 days. Furthermore, the varying divisions in the scale do not occur in any particular sequence. The first division has 31 subdivisions; the second, 28; the third, 31; the fourth, 30; and so on. If the foot rule were divided into such erratic divisions, we would certainly have difficulty in computing the dimensions of an object. For any real and valid comparison in our calendar we must necessarily rely on the subdivision which represents a day. We try to measure time with an instrument, only one subdivision of which—the twenty-four-hour day—is exact, invariable, and practical. Thus the uneven character of the months makes the calendar structurally inconsistent for practical and precise use.

Now let us see what this variable measurement does to one year, 1942, for example.

ANALYSIS OF THE CALENDAR YEAR 1942

In Table I the year 1942 is analyzed in terms of its diverse components. The year is broken up into the four quarters representing three months each. Each month, in turn, is considered in terms of the day of the week on which it begins and ends; of the number of times the seven days of the week occur in it; of the number of weeks it is composed of; and, finally, the number of days it contains. (For the 1942 calendar, see Table XIV, page 108.)

Quarters and Halves. In Table I we observe that the first quarter contains 12 6/7 weeks or 90 days, the second exactly 13 weeks or 91 days, and the third and the fourth quarters 13 1/7 weeks or 92 days each. This phenomenon holds true for all common years. In leap years, however, the first quarter contains exactly 13 weeks or 91 days. Obviously such an uneven arrangement gives unequal and inaccurate quarters. Similarly, it creates two halves of 181 and 184 days in common years and two halves of 182 and 184 days in leap years. This mathematical enigma becomes more apparent when we see that, for quarters, the numbers 365 and 366 are not integrally divisible by four.

The Days of the Week. To obtain a more detailed perspective of our calendar, however, we need to scrutinize the data in the vertical columns of Table I with an eye to comparisons. Here we discover that the month of January began on a Thursday, February on a Sunday, March on a Sunday, and so on. There is no semblance of regularity or of order in which the different months begin. The difficulty is increased by the fact that 1942 bears no resemblance either to the year that has passed or to the

TABLE I. ANALYSIS OF THE CALENDAR YEAR 1942

Month	*Day on Which the Month—*		*Number of Times Each Day of the Week Occurs in the Month*							*Number of Weeks in the Month*	*Number of Days in the Month*
	Begins	*Ends*	*Sun.*	*Mon.*	*Tues.*	*Wed.*	*Thur.*	*Fri.*	*Sat.*		
January	Thursday	Saturday	4	4	4	4	5	5	5	4 3/7	31
February	Sunday	Saturday	4	4	4	4	4	4	4	4	28
March	Sunday	Tuesday	5	5	5	4	4	4	4	4 3/7	31
At the End of First Quarter We Have ⟶										12 6/7 *weeks or* 90 *days*	
April	Wednesday	Thursday	4	4	4	5	5	4	4	4 2/7	30
May	Friday	Sunday	5	4	4	4	4	5	5	4 3/7	31
June	Monday	Tuesday	4	5	5	4	4	4	4	4 2/7	30
At the End of Second Quarter We Have ⟶										13 *weeks or* 91 *days*	
July	Wednesday	Friday	4	4	4	5	5	5	4	4 3/7	31
August	Saturday	Monday	5	5	4	4	4	4	5	4 3/7	31
September	Tuesday	Wednesday	4	4	5	5	4	4	4	4 2/7	30
At the End of Third Quarter We Have ⟶										13 1/7 *weeks or* 92 *days*	
October	Thursday	Saturday	4	4	4	4	5	5	5	4 3/7	31
November	Sunday	Monday	5	5	4	4	4	4	4	4 2/7	30
December	Tuesday	Thursday	4	4	5	5	5	4	4	4 3/7	31
At the End of the Fourth Quarter We Have ⟶										13 1/7 *weeks or* 92 *days*	

year that is to follow. In the same manner this chaotic situation holds true for the closing days of the various months, as is indicated in column 3. A further analysis of the first three columns brings out the following facts regarding the beginning and ending of the different months:

	Number of Months	
	Beginning on	*Ending on*
Sunday	3	1
Monday	1	2
Tuesday	2	2
Wednesday	2	1
Thursday	2	2
Friday	1	1
Saturday	1	3

Thus we see that in 1942 three months began on a Sunday and one ended on a Sunday; one month began on a Monday and two months ended on a Monday; and so on. There is obviously so little uniformity or logic in such an arrangement that, without consulting a calendar, only a rare person can tell on what day of the week a certain month begins or ends.

Further study of Table I will indicate that, during the month of January, Thursday, Friday, and Saturday occurred five times each, while Sunday, Monday, Tuesday, and Wednesday occurred only four times each. The frequency of the days of the week varies with the number of days in the month and is different from month to month. We also discover that the months of March, May, August, and November had five Sundays each, while the remaining months, January, February, April, June, July, September, October, and December, had four Sundays each. A parallel situation holds for the remaining six days of the week. This variable nature of the days of the week is more clearly seen when we make comparisons from year to year.

It is apparent, then, that there is hardly any synchronization between the dates and the days of the week in our calendar. However, we should not be confounded by such a situation if we had a standard month containing a number of whole weeks and so planned that it began on a fixed day and ended on a fixed day. On such a basis, assuming that the first of every month fell on a

TABLE II. SUMMARY GREGORIAN CALENDAR,* A. D. 1752–1971

Calendar Years									Number of Calendar-Month											
									Jan.	*Feb.*	*Mar.*	*Apr.*	*May*	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*
1752†	*1780*		*1820*	*1848*	*1876*		*1916*	*1944*	7	17	4	14	2	12	7	3	13	1	11	6
1753	1781		1821	1849	1877		1917	1945	2	26	5	8	3	13	1	4	14	2	12	7
1754	1782		1822	1850	1878		1918	1946	3	27	6	9	4	14	2	5	8	3	13	1
1755	1783	**1800**‡	1823	1851	1879		1919	1947	4	28	7	10	5	8	3	6	9	4	14	2
1756	*1784*		*1824*	*1852*	*1880*		*1920*	*1948*	5	15	2	12	7	10	5	1	11	6	9	4
1757	1785		1825	1853	1881		1921	1949	7	24	3	13	1	11	6	2	12	7	10	5
1758	1786		1826	1854	1882		1922	1950	1	25	4	14	2	12	7	3	13	1	11	6
1759	1787		1827	1855	1883	**1900**‡	1923	1951	2	26	5	8	3	13	1	4	14	2	12	7
1760	*1788*		*1828*	*1856*	*1884*		*1924*	*1952*	3	20	7	10	5	8	3	6	9	4	14	2
1761	1789	1801	1829	1857	1885		1925	1953	5	22	1	11	6	9	4	7	10	5	8	3
1762	1790	1802	1830	1858	1886		1926	1954	6	23	2	12	7	10	5	1	11	6	9	4
1763	1791	1803	1831	1859	1887		1927	1955	7	24	3	13	1	11	6	2	12	7	10	5
1764	*1792*	*1804*	*1832*	*1860*	*1888*		*1928*	*1956*	1	18	5	8	3	13	1	4	14	2	12	7
1765	1793	1805	1833	1861	1889	1901	1929	1957	3	27	6	9	4	14	2	5	8	3	13	1
1766	1794	1806	1834	1862	1890	1902	1930	1958	4	28	7	10	5	8	3	6	9	4	14	2
1767	1795	1807	1835	1863	1891	1903	1931	1959	5	22	1	11	6	9	4	7	10	5	8	3
1768	*1796*	*1808*	*1836*	*1864*	*1892*	*1904*	*1932*	*1960*	6	16	3	13	1	11	6	2	12	7	10	5
1769	1797	1809	1837	1865	1893	1905	1933	1961	1	25	4	14	2	12	7	3	13	1	11	6
1770	1798	1810	1838	1866	1894	1906	1934	1962	2	26	5	8	3	13	1	4	14	2	12	7
1771	1799	1811	1839	1867	1895	1907	1935	1963	3	27	6	9	4	14	2	5	8	3	13	1
1772		*1812*	*1840*	*1868*	*1896*	*1908*	*1936*	*1964*	4	21	1	11	6	9	4	7	10	5	8	3
1773		1813	1841	1869	1897	1909	1937	1965	6	23	2	12	7	10	5	1	11	6	9	4
1774		1814	1842	1870	1898	1910	1938	1966	7	24	3	13	1	11	6	2	12	7	10	5
1775		1815	1843	1871	1899	1911	1939	1967	1	25	4	14	2	12	7	3	13	1	11	6
1776		*1816*	*1844*	*1872*		*1912*	*1940*	*1968*	2	19	6	9	4	14	2	5	8	3	13	1
1777		1817	1845	1873		1913	1941	1969	4	28	7	10	5	8	3	6	9	4	14	2
1778		1818	1846	1874		1914	1942	1970	5	22	1	11	6	9	4	7	10	5	8	3
1779		1819	1847	1875		1915	1943	1971	6	23	2	12	7	10	5	1	11	6	9	4

Example: To determine the day of the week corresponding to July 4, 1820, take the following steps:

1. Locate the year 1820 in the left half of the above table. 2. On the right half of the above table, under July find the number of the type of Calendar-Month in line with *1820*. This number of Calendar-Month is 7. 3. The Calendar-Month under the circle *7* on the opposite page furnishes Tuesday for July 4, 1820, as the answer.

* Adapted from "A Calendar for History Students," by Carl Edward Larsen, Casper, Wyoming.

† Italicized numbers indicate leap years. ‡ The years 1800 and 1900 were common years according to the Gregorian rule.

TWENTY-EIGHT DIFFERENT KINDS OF OUR CALENDAR-MONTHS

31 Days

①

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	·	·	·	·

②

·	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31	·	·	·

·	·	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31	·	·

·	·	·	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	·

·	·	·	·	1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

⑥

·	·	·	·	·	1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31	·	·	·	·	·	·

⑦

·	·	·	·	·	·	1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31	·	·	·	·	·

30 Days

⑧

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	·	·	·	·	·

⑨

·	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	·	·	·	·

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·	·	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	·	·	·

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·	·	·	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	·	·

⑫

·	·	·	·	1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	·

⑬

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3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

⑭

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2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	·	·	·	·	·	·

29 Days

⑮

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	·	·	·	·	·	·

⑯

·	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29		·	·	·	·

⑰

·	·	1	2	3	4	5
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13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	·		·	·

⑱

·	·	·	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	·	·	·

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4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	·	·

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10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	

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·	·	·	·	·	·	1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29

28 Days

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28

·	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	·	·	·	·	·	·

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·	·	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	·	·	·	·	·

·	·	·	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	·	·	·	·

·	·	·	·	1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	·	·	·

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·	·	·	·	·	1	2
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10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	·	·

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2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	

Sunday, one would experience little difficulty in finding that the fourth day of every month would fall on a Wednesday, the seventh on a Saturday, the twelfth on a Thursday, and so on. With such a fixed standard the days of the week and the dates would always correspond from month to month and from year to year.

If you were to determine on what day of the week a certain date fell, say July 4, 1820, you could not conveniently do so without the aid of a calendar of that particular year. A device (Summary Gregorian Calendar, 1752-1971) to facilitate finding the day of the week, for any date from A.D. 1752 to A.D. 1971, is given on pages 16 and 17. The example at the bottom of page 16 illustrates the use of the Summary Gregorian Calendar.

Weeks and Months. Let us see how much consistency there is in the weekly subdivisions of the month. The day, the lunar month, and the solar year are natural units of time. The week is not a natural unit of time even though it approximates one of the four phases of the moon. It was devised by man to set aside a ritual day of rest growing out of taboos related to the moon. The idea of a weekly subdivision also grew out of the practice of fixing a regular and recurring market day for the exchange of goods and for communal activities. Religious practice eventually fixed this weekly subdivision as a unit of time in our calendar.

The week is now set in our habits and we rely on it as an intermediary unit between a day and a month. However, we cannot conveniently use it as a fraction of a month or of a year because neither of them is integrally divisible by seven. This difficulty will be apparent by a further review of Table I, the column entitled "Number of Weeks in the Month." An analysis of this column gives the following facts: seven months have 4 3/7 weeks; four months have 4 2/7 weeks; and one month has exactly four weeks. Only one month, February, has an integral number of weeks; the rest have four weeks plus a fraction of a week. However, even this bit of exception crumbles during a leap year, when February has 4 1/7 weeks. Thus the months can be broken into four different categories consisting of 4, 4 1/7, 4 2/7, and 4 3/7 weeks.

This variegated structure of the weeks in a month contributes to another difficulty—the split week. It will be noted that, in the calendar year 1942, January and October began with a split week and ended on a Saturday. March and November began on a Sunday and ended with a split week. The solitary month of February is conspicuous in beginning on a Sunday and ending on a Saturday, thereby giving us a month without a split week. The rest of the seven months began and ended with a split week. So long as the numbers of days in the month are not integral multiples of seven, it is obviously impossible to have months that are composed of full weeks only. Likewise, in a common year we have 52 1/7 weeks and in a leap year 52 2/7 weeks and, consequently, the split week holds sway.

Furthermore, since a month may begin on any one of the seven days of the week in a period of four years, there will be a combination of twenty-eight distinctly different kinds of month (see page 17). Also, since our calendar contains common and leap years which may begin on any one of the seven days of the week, we have fourteen distinctly different kinds of year (see Table III). Such great diversity makes a labyrinth of what is presumably a standard.

If only Mother Earth would accommodate us and revolve around the sun in 364 days, this impasse could be avoided!

Days in a Month. One cannot always tell how many days there are in a month without counting on the knuckles and grooves on the back of the closed fist or without the aid of one of the many mnemonic rhymes developed for just that purpose. One of these rhymes runs like this:

> Thirty days hath September,
> April, June, and November.
> All the rest have thirty-one,
> Save February. She alone
> Hath eight days and a score
> Till leap year gives her one day more.

This range of days in a month is manifest in the final column of Table I, where we find that seven months have 31 days, four have 30 days, and one 28 days. In a leap year February has 29 days. Thus we have months of four different durations.

Such variability in the number of days of the months and such

TABLE III. THE GREGORIAN YEARS WITH IDENTICAL CALENDAR

A.D. 1752—A.D. 2000

(The day of the week on which New Year's Day occurred in corresponding years)

C.Y. = Common Years L.Y. = Leap Years

Century	*Sunday*		*Monday*		*Tuesday*		*Wednesday*		*Thursday*		*Friday*		*Saturday*	
	C.Y.	*L.Y.*	*C.Y.*	*L.Y.*	*C.Y.*	*L.Y.*	*C.Y.*	*L.Y.*	*C.Y.*	*L.Y.*	*C.Y.*	*L.Y.*	*C.Y.*	*L.Y.*
Eighteenth														1752
			1753		1754		1755			1756			1757	
	1758		1759			1760			1761		1762		1763	
		1764			1765		1766		1767			1768		
	1769		1770		1771			1772			1773		1774	
	1775			1776			1777		1778		1779			1780
			1781		1782		1783			1784			1785	
	1786		1787			1788			1789		1790		1791	
		1792			1793		1794		1795			1796		
	1797		1798		1799									
							1800							
Nineteenth									1801		1802		1803	
		1804			1805		1806		1807			1808		
	1809		1810		1811			1812			1813		1814	
	1815			1816			1817		1818		1819			1820
			1821		1822		1823			1824			1825	
	1826		1827			1828			1829		1830		1831	
		1832			1833		1834		1835			1836		
	1837		1838		1839			1840			1841		1842	
	1843			1844			1845		1846		1847			1848
			1849		1850		1851			1852			1853	
	1854		1855			1856			1857		1858		1859	
		1860			1861		1862		1863			1864		
	1865		1866		1867			1868			1869		1870	
	1871			1872			1873		1874		1875			1876
			1877		1878		1879			1880			1881	
	1882		1883			1884			1885		1886		1887	
		1888			1889		1890		1891			1892		
	1893		1894		1895			1896			1897		1898	
	1899													
			1900											
Twentieth					1901		1902		1903			1904		
	1905		1906		1907			1908			1909		1910	
	1911			1912			1913		1914		1915			1916
			1917		1918		1919			1920			1921	
	1922		1923			1924			1925		1926		1927	
		1928			1929		1930		1931			1932		
	1933		1934		1935			1936			1937		1938	
	1939			1940			1941		1942		1943			1944
			1945		1946		1947			1948			1949	
	1950		1951			1952			1953		1954		1955	
		1956			1957		1958		1959			1960		
	1961		1962		1963			1964			1965		1966	
	1967			1968			1969		1970		1971			1972
			1973		1974		1975			1976			1977	
	1978		1979			1980			1981		1982		1983	
		1984			1985		1986		1987			1988		
	1989		1990		1991			1992			1993		1994	
	1995			1996			1997		1998		1999			**2000**

variability in the frequency of the days of the week in a month result in a diversity of weekdays from month to month. By deducting the number of Sundays from the total number of days in a month, we get the number of weekdays in that month. The following list gives the number of weekdays for the months of the year 1942:

Month	*Weekdays*
February	24
November	25
March, April, May, June, August, September	26
January, July, October, December	27

THE CALENDAR AND OUR SOCIAL AND INDUSTRIAL NEEDS

Just how does this variation in our calendar affect the average citizen? Is it geared to meet the needs of our present-day production efficiency and way of living? Does it accord with our present scientific knowledge?

After all, the calendar grew up around holy days and other days of special social significance. Our holidays have the same basic religious, social, and recreational foundations as those of older times; therefore they warrant examination.

FLUCTUATIONS OF THE "NATIONAL HOLIDAYS"

What are usually known as national holidays[8] fall into two distinct categories. Either the date is fixed or the day of the week is definitely specified. In our present calendar, the date and the day of a holiday can never coincide from year to year; that is, the Fourth of July cannot be on the same day of the week in 1943 and 1944, nor can Thanksgiving, which always comes on a Thursday, be on the same date in two consecutive years. An extra day in common years and two extra days in leap years—an excess over the fifty-two weeks of the year—make this impossible, as is shown by what has happened in the case of New Year's Day during a succession of twelve years: [4]

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[8] In the United States there are no "national holidays." Each state has jurisdiction over and therefore the right to declare the holidays it deems fit. Holidays are either designated by individual state legislatures or proclaimed by the governor. The only national holiday in the history of the United States was the one-hundredth anniversary of the Constitution, and it was proclaimed by Congress.

1931	Thursday	1935	Tuesday	1939	Sunday
1932	Friday	1936	Wednesday	1940	Monday
** 1933	Sunday	** 1937	Friday	** 1941	Wednesday
1934	Monday	1938	Saturday	1942	Thursday

It will be observed from these data that New Year's Day drifts one day from year to year in ordinary years because of the three hundred sixty-fifth day, which constitutes one day in excess of fifty-two weeks. But on the years following leap year, as indicated by the double asterisks, there is a jump of two days. This two-day jump results from the fact that in every leap year there are two days in excess of fifty-two weeks. New Year's Day drifts and jumps through the seven days of the week. Thus in 1931, the holiday fell on a Thursday, during the latter half of the week; in 1932, just before the end of the week; in 1933, on a Sunday; and in 1934, near the beginning of the week, and so on.

New Year's Day. Among all peoples in all ages, the first of the new year was generally observed as a festival, marking the cycle of new life. The date has varied widely, depending on the locale, seasons, and the manner of reckoning time. The Christian New Year's Day celebrates the Feast of Circumcision. The Jewish New Year's Day is called the Feast of Trumpets, when the shofar is blown to proclaim the arrival of the new year. Among the Chinese the day is the greatest festival of the year.

Further examination of our holidays will show how their irregularity affects the efficiency of industrial and social institutions. If our calendar were an adequate instrument of measurement, the holidays would remain consistent in relation to both the dates and the days of the week. If our calendar were a scientific standard, it would eliminate the necessity of renewing the yearly holiday schedules and would, by and large, enhance individual, industrial, and social efficiency. As our calendar stands, when a fixed date is indicated, the day of the week shifts from

[4] Computed from *Summary Gregorian Calendar, 1752-1971*: Table II, pp. 16, 17. This table helps us to ascertain the day of the week for any given date and begins with A.D. 1752 when the present (Gregorian) calendar was first inaugurated in this country, and ends with A.D. 1971.

year to year; or when a specific day of the week is indicated by some such confounding expression as the "first Tuesday after the first Monday in November" for Election Day, the date shifts from year to year. Thus New Year's Day, Independence Day, and Christmas Day occur on definite dates but may occur on any of the seven days of the week. On the other hand, Easter, Election Day, and Thanksgiving Day are specified to occur on definite days of the week but fall on dates that fluctuate from as wide a range as thirty-five days in the case of Easter, to a maximum of seven days in other cases.[5]

Unless a holiday occurs on a Monday or a Saturday, it breaks the sequence of the work week, thus interrupting the productive process. Stopping and starting machinery involves waste and materially affects the efficiency of a plant or an enterprise. Welcome as a holiday may be, usually it is more welcome when it occurs along with other rest days. The longer holiday can be used advantageously for work or play, for visits and travel, for hobbies or other recreational pursuits. A good example of this situation occurred recently in the state of New York. Because of the New York "190 school-days" statute, what might otherwise have been a long Christmas–New Year holiday was split by the opening of the schools on Friday, January 2, 1942, only to close again for the following two week-end days. The necessity of opening public schools in New York City for this Friday cost the city an estimated sum of $22,259.[6] One can easily see the economic waste involved in just one unit of the school establishment when the heating plants have to be started for one day after a long vacation, only to be shut off for another two days. Besides, such a break has certain psychologically vitiating effects on students, and the day's achievement in the school might naturally be of dubious value.

Easter and Business. Tradition has given Easter a unique function as the herald of spring. All ancient peoples in the northern hemisphere marked the renewal of life upon the earth at the vernal equinox by ritual festival. And for many peoples, the arrival of spring ushered in the new year. From remote antiquity man has made use of some symbol to carry the idea of renewal, redemption, and rebirth.[7] Our painted Easter eggs are such a symbol and have a long history, as the Persians used them long before the Christians did. Red eggs symbolized the redeeming blood of the Saviour, as did the wine of the Communion Supper. The Passover meal also symbolized the beginning of the cycle of nourishment, death, and rebirth. Easter was the vernal new year, and at this period man sought to give expression to the renewal of the outer world by way of some symbolic idea and act. The Jewish Passover as well as the Christian Easter, no less than the earlier spring festivals of the Egyptians, Babylonians, and Hindus, incorporated the idea of death and rebirth. At Easter time the indoors were ritually freshened and new ritual garments put on. Today, variations in our business life are markedly affected by this ancient tradition. And because Easter was originally related to a fluctuating moon calendar, its peregrinations cause great inconvenience in our business today.

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[5] For a concise treatment of Lincoln's and Washington's birthdays, Memorial Day, Independence Day, Labor Day, Election, Thanksgiving Day, and Christmas see Appendix A. For a complete treatment, see the series by R. H. Schauffler, *Our American Holidays.* Dodd, Mead & Company, New York.

[6] *New York World-Telegram,* January 2, 1942 (last edition).

The Easter celebrations branched off from the Hebrew *Pasch*, the Passover, and merged with the spring festival of other peoples. The evidence of this relationship is found in the philological derivation of the word Easter. Easter is the Anglicized version of the name of the Teutonic goddess *Eastre*. She bears a striking resemblance to the moon goddess *Ishtar*, who presided over the spring festival marking the beginning of the Babylonian year. Because of the relationship of the Last Supper to the Jewish Passover, the early Church made Easter concur with the Jewish holiday.

This situation continued until the Council of Nicea, when the new rule for Easter was formulated. In A.D. 325, Emperor Constantine specified the new date of Easter on the advice of this highest Christian Council, which met to bring about the unification of all Christendom under the Empire of Constantine. Easter was designated to be observed on the Sunday following the first full moon after the vernal equinox. The principal reason for choosing the time of the full moon was to afford pilgrims safe passage on the roads to Jerusalem, as they traveled to the Holy City for the Easter festival. The light of the full moon enabled them to travel in comparative security by night as well as by day.

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[7] A. E. Haydon, *Biography of the Gods*. The Macmillan Company, New York, 1942.

By 1582, because the civil year was at variance with the solar year, the vernal equinox had drifted to March 11 of the Julian Calendar (see p. 71). To correct this condition and to restore the equinox to its former place, Pope Gregory XIII established the equinox on March 21 to align it with the date observed during the Nicean Council. The earliest date on which Easter could occur would be March 22, falling on a Sunday and having a full moon. The latest date would be April 25, one lunar month and six days later; this would occur when the full moon falls on March 21 and the day happens to be a Sunday. This is precisely what happened in 1943. The full moon occurred on the day of vernal equinox, March 21, and so Easter was observed on Sunday following the next full moon, April 25. We see, then, that Easter oscillates over a period of 35 days, anywhere between March 22 and April 25, inclusive.

Figure 2 records the oscillations of Easter for thirteen years from 1932 to 1944. It looks like a fever chart. In 1932 Easter Sunday fell on March 27; then it swung forward to April 16 in 1933; and so on back and forth. In 1940 it occurred on March 24 and in 1943 on April 25.[8] Such is the eccentric course of a "fixed" Easter in our current Gregorian Calendar.

The variability of the date for Easter causes many dislocations in social habits and relationships, in religious observances and school holidays, and in certain trades. The arrival of Easter today is associated with the purchasing of new clothing, installing warm-weather fixtures, sprucing up the home, and resuming active outdoor recreation. All of us are subjected in some degree to the vagaries of Easter when we make plans or schedules for modern needs, little realizing that we are bound to an instrument of time measurement developed out of the needs of a medieval culture.

[8] March 24 is the *most unusual* Gregorian Easter date. The occurrence of Easter on this date in 1940 was the second time since the Gregorian reform, and will not occur again until A.D. 2391. The March 22 Easter will not occur again until A.D. 2285; the April 25, not until A.D. 2038.

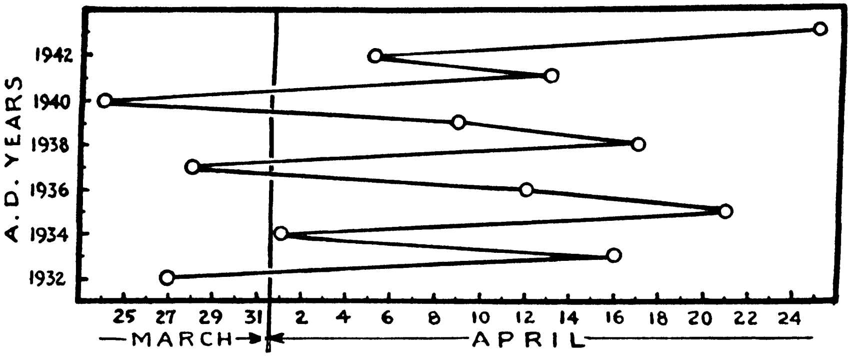

Figure 2. The Eccentric Course of Easter

Brief consideration of the relation between the calendar and the social habit of purchasing clothes just before Easter week will suffice to illustrate the havoc which the movable Easter plays with business life. The management of a fairly large business maintains a statistical record of sales from month to month and from year to year. Current data are compared with past data as a guide in planning future buying and selling. However, the clothing merchant, despite his weighting and bridging, cannot apply this comparative statistical technique to his data for the months of March and April. He might surmise that business during a certain March was down sharply because Easter did not come until late in April that year, whereas another year it came in March. The only thing he can say definitely is that Easter is an important factor in the fluctuation of his sales. But he cannot determine the degree of its importance because there are no comparable figures. The wandering Easter has thrown his data out of gear for two months of the year and rendered them useless for statistical comparison. He is forced to base judgments and predictions on guesswork so far as these two months are concerned.

Statistical and Industrial Confusions. What is true for the clothing merchant in March and April holds true for industry and business at large when any two months, say, February and March, of 28 and 31 days are compared. Here we have a disparity of approximately 10 per cent. Contributing to the confusion is the varying number of weekdays in consecutive months. In January of the year 1942, for instance, there were 27 weekdays, in February, 24, and in March, 26. On the other hand, in 1943, January had 26 weekdays, February, 24, and March, 27. This variation from month to month and from year to year calls for considerable adjustment in order to obtain comparable data.

One of the basic units with which the statistician deals is time. Statistics, whether related to commerce or to finance, to population or to land area, to production or to raw material, must necessarily consider dates. The statistics involved in recording births, marriages, and deaths alone provide ample evidence of the diverse fields for which exact data are required.

The 28-, 29-, 30-, and 31-day months and the haphazard way in which the holidays occur make statistical calculations for months highly complicated and call for constant corrections to obtain comparable data. Thus a month containing five Saturdays and five Sundays will produce an entirely different record from the corresponding month of the previous year with four Saturdays and four Sundays. Consequently, a direct comparison of data for corresponding months in consecutive years cannot be interpreted readily. They must be interpreted through the use of adequate corrective factors.

Statistics constitute the very basis of scientific analysis in our industrial and economic life today; precise units of time are vital to such statistics. Regularity, uniformity, and precision are imperative for any data that need to be compared and analyzed; the subdivisions of our calendar are neither precise nor regular. No amount of simplified recording, bookkeeping, and accounting will overcome the difficulty of attempting to use data that are invalid for comparison in terms of accurate time periods.

The value of statistics depends largely upon the extent to which they permit accurate comparisons to be made between the current figure, say, of production and sales for a given period, and similar figures for corresponding periods in the past. If the data are to be accurately compared, the periods must be the same or reducible to the same basis. Quantitative statistical errors result from the differing lengths of the periods into which the year is divided. Qualitative errors result from the varying numbers of weekdays, month by month, quarter by quarter, and year by year. Furthermore, this situation is complicated by the fact that, as indicated before, holidays are erratically distributed throughout the year.

Dividends, interests, and other financial payments are frequently made on quarterly and half-yearly bases. The Federal income tax law provides for payment of taxes on a quarterly, half-yearly, and yearly basis. The same is true, in most cases, for local and state taxes. Most calculations of wages and insurance, expenditures and incomes, profits and losses, rents and dues, production and turnover are fixed on either a monthly, a quarterly, or a half-yearly basis. Since the month, quarter, and half-year never correspond exactly with one-twelfth, one-fourth, or one-half of the year, the data for those periods are not easily compared until the disparities have been adjusted. Banks, for instance, use special tables that compensate for this disparity. To complicate this situation further many commercial and public agencies follow a fiscal year which is different from the calendar year. The Federal government closes its fiscal year on June 30, as do many state and local governments.

Transportation Schedules. The week-end, when millions of workers are freed from their shops and factories, is a time of heavy travel. Over the usual day-and-a-half week-end a normal number of train passengers may be expected. But when a holiday comes on a Saturday or a Monday, there are abnormal complications in traffic. A lengthened week-end provides a fair amount of time for pleasure trips and stimulates business activity in gasoline stations, roadside restaurants, resorts, and out-of-town hotels. We live in an age of rapid transportation. Steamships, buses, trains, and airplanes link the different places of the world by water, land, and air. All these modes of travel must of necessity run on schedule if they are to furnish efficient service to the traveler.

Transportation agencies are guided by statistics and by the calendar in anticipating traffic peaks and in planning their operating schedules. Transportation schedules are made with the utmost care and are as sensitively coordinated as the various parts of a precision clock. When we consider the facility, convenience, and punctuality with which we travel today, we begin to realize the amount of effort, ingenuity, timing, and correlation involved in the conception and operation of schedules within our varying calendar. For instance, the transportation needs of the Fourth of July of 1942, which fell on a Saturday, were different from those of the previous year, when that holiday fell on a Friday, and entirely different from those of the year before that, when it fell on a Thursday. In a circumstance like this, the transportation companies are forced to make the best of the situation and to rely on their judgment.

In contrast is the long Labor Day week-end which, because of its stability, provides a reliable measure to the transportation companies. In this case they compile consistent and comparable statistics from year to year and can plan without recourse to complicated computations or sheer surmise. Under the present calendar, Labor Day is the only holiday upon which the traveling public can depend for a long week-end excursion. Transportation statistics indicate that the traffic data for this peak period are fairly uniform.

The "wandering day" characteristic of our calendar causes another difficulty to transportation. In some months there are four Sundays and in others five. The summation of a business situation in a January which had four Sundays cannot accurately be compared with that of a January of five. And if, perchance, a Friday or Monday holiday extended the week-end, the data would prove even less comparable. The same difficulty follows from the variation in the length of months. Thus, January figures cannot be compared with those of February without complex adjustments, because January is three days longer in common years and two days longer in leap years. It is not hard to imagine the definite loss of time, effort, money, and accuracy involved under our present calendar in making transportation schedules and obtaining comparable statistics.

The School Year. The inconsistencies of the calendar also affect the planning of the school year. In the United States it is customary for many urban schools to begin their school year on Tuesday after Labor Day. But Labor Day is designated as the first Monday in September and, therefore may occur anywhere from September 1 to September 7. Accordingly, the opening of school fluctuates from September 2 to 8, inclusive. This irregularity affects the number of school days between the opening date and Christmas. It lengthens the school period when Labor Day occurs on the first and shortens it when Labor Day occurs on the seventh. Most states prescribe a minimum requirement of teaching days to entitle the schools to state subsidy for education. For instance, in New York State the minimum requirement is 190 school days; therefore, a late Labor Day must be compensated for by a shortened Christmas or Easter vacation, or a late closing in June.

In rural areas, the school calendar frequently varies regionally, hinged as it often is on the needs dictated by regional crops. In Florida it is common practice, in the rural sections, to grant annual winter school vacations to enable children to help in harvesting the winter crops. Since this practice originated in the strawberry-growing areas, such schools in Florida are known as "strawberry schools." This is an excellent example of the adjustment of social institutions to economic needs, which in turn are conditioned by geographical and seasonal exigencies. This situation is also applicable to Maine, in late fall, where the potato crop is the dominating factor, and applies to many other rural areas in different states of the Union where seasonal crops are involved.

With the possible exception of the transportation agencies, there is probably no other single group more harassed by the irregularities of the calendar than the planners of school calendars. The laying out of a school calendar being an intricate and involved task, the planners must prepare the curriculum and schedule classes. They must make adequate arrangement for examinations and graduation exercises. First, they must consider the set number of days to be provided to meet institutional or legal requirements. Then they must conform their plans to the quarter or semester term that may be current. They must consider the special days of religious observance of various groups. They must fit in the shorter holidays as evenly as possible throughout school terms. They must consider holidays of a patriotic character that have national, regional, state, or local importance. They must comply efficiently with the eccentric character of Easter and with the Christmas-New Year holiday. In most educational institutions, Christmas holidays vary from ten days to two weeks, depending on the day of the week on which Christmas falls. Thus if it falls on a Friday, the vacation starts on Friday and continues until a week from the following Monday. However, if it falls on a Tuesday, it must be determined whether the holidays should commence on the Saturday before Christmas and provide a longer period, or start on Tuesday. Add to this the consideration that must be given to extracurricular activities which give rise to a whole series of schedules to be accommodated within the framework of the academic year.[9] The planners must make proper provision for school activities, athletic meets, Homecoming, Alumni Day, Parents' Day, educational conventions, and other special occasions.

Thus, planning the school year constitutes a task of huge proportions that must be *repeated* each year. The ever-changing character of the calendar makes this planning tedious and complicated, and involves considerable waste of effort in time, anxiety, annoyance, and energy. Considering just the 248,000 schools, colleges, and universities in continental United States that must reschedule their programs every year, we see that the social waste assumes staggering proportions. It would be interesting if an appraisal of the annual man-hours lost in the planning of school calendars could be made to cover the entire national field embracing all grades of educational institutions—public, private, and parochial. A standard calendar that repeated itself from year to year would obviously prove a boon to the planners of such schedules. Coordination of time units and standardization in the measure of time would eliminate irrationalities and would result in the saving of a great deal of time and money now wasted in the effort to compensate for the irregularities.

How much simpler it would be if we had a standard which eliminated the shifting vagaries of our calendar! How desirable in reckoning time units to have an instrument which was uniform and invariable from year to year, and from century to century!

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[9] E. K. Fretwell, *Extra-Curricular Activities*. Houghton Mifflin Company, Boston, 1931.

CHAPTER II

BASIC CALENDAR CONCEPTS

> *"The methods of measuring time grew up about the need for determining the dates of the tabooed or holy days, and for fixing and recording the occurrence of unusual natural phenomena which were believed to have some regular significance. . . . The perfection of the methods of measuring time has been a gradual transition 'from luck to mathematics'."*
>
> —HARRY ELMER BARNES[1]

EARTH—THE NATURAL CLOCK

PLANNING a calendar is not a simple matter. Many unequal divisions of time have to be considered, and trying to fit them together is a complicated process which calls for precise knowledge relating to earth, moon, and sun. However, man's basic timepiece is his own rotating and revolving earth.

Three fundamental movements determine our concepts of time. We get our diurnal and nocturnal concepts from the axial rotation of the earth; our monthly (synodic) concept from the revolution of the moon around the earth; and, finally, the seasonal and annual concepts from the revolution of the earth around the sun. These three factors constitute the antecedents and the bases of practically all calendars.

The earth averages one rotation on its axis in twenty-four hours, or one civil day, and makes one revolution around the sun in about 365.2422 days, or one *tropical* year. The moon makes one complete circuit around the earth in 29.530588 days, or one synodic month.[2] But 365.2422 is not evenly divisible by 29.530588; therefore there cannot be a specified number of complete synodic months in a solar year.

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[1] H. E. Barnes, *The History of Western Civilization,* Vol. I, p. 105. Harcourt, Brace and Company, New York, 1935.

[2] The length of the tropical year is not absolutely constant. Astronomers tell us that, because of tidal friction, the rotations of the earth and the revolutions of the moon are slowing down. Consequently, the actual durations of the day and of the synodic month are lengthening. The day is lengthening by about $0^s.001$ per century, and the synodic month is increasing by $0^s.27$ every hundred years. The

The attempt to reconcile and integrate the day, the month, and the year with the needs of religious and social customs has been the despair of all calendar makers. Their difficulties have been complicated by the fact that the mean noon (twelve o'clock) varies throughout the year and deviates a maximum of approximately sixteen and a half minutes from true noon.

Thus the civil day, which directs our day-to-day activities, the synodic month, which plays a vital part in the study of the tidal phenomenon and is woven into the fabric of our calendar as approximating a month, and the tropical year, which regulates our seasons, constitute three basic periods with which we must deal. Neither the tropical year nor the synodic month is integrally divisible by the civil day. Nor is the tropical year integrally divisible by the synodic month. This incommensurability of day, month, and year presents a difficulty in the simplification of the calendar. The day as a unit by itself could easily be reconciled with either the tropical year or the synodic month by inserting an extra day to compensate for the accumulated residual fractions. (Such an insertion of an additional day or days in the calendar, to make it accord with the lunar month or solar year, is called *intercalation.*) However, all three could not be combined to obtain an exact, regular, comparable, and consistent standard for time measurement. Such a standard would require that the month or the year be sacrificed as a time unit. Elimination of the tropical year is out of the question because that unit alone furnishes an indispensable measure which keeps the seasons in step from year to year. Therefore, if we seek to maintain the regularity of the seasons in the framework of a calendar, the *synodic* month must be eliminated as a unit of time reckoning.

The word *month* is used with a variety of meanings. For instance, the *nodical* month is measured by the moon's return to one of its nodes. The *sidereal* month is calculated as the mean time of revolution from any star back to the same star. Finally, the *synodic* month is marked by the lunar phases, the time reck-

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tropical year, on the other hand, is decreasing at the rate of about $0^s.5$ per hundred years. For further treatment of this topic, see *The Tides and Kindred Phenomena in the Solar System* by G. H. Darwin, 3rd edition, pp. 279-283. John Murray, London, 1911.

oned from one full moon to another, or from one new moon to the following new moon. The values of these differ, as is indicated below:

Nodical month	27.212220 days
Sidereal month	27.321661 days
Synodic (lunar) month	29.530588 days—a lunation

Because the moon's nodes regress, the nodical month is shorter than the sidereal month, while the forward motion of the earth around the sun causes the synodic month to be longer than the sidereal month. The synodic month (a *lunation*) has been associated with religious observances and thus has played an important role in the consideration of calendars.

Throughout the known history of man there have been three kinds of calendar: the lunar, the solar, and the luni-solar. We shall consider each in turn.

THE LUNAR CALENDAR

Practically all early peoples used the lunation, a period of about 29½ days, as a criterion, and measured the month from one new moon to another or from one full moon to another. Most cultures using the lunation as a standard unit dropped the half-day in one month and compensated for it by adding an extra day in the following month, thereby reckoning the months by the alternating 30 and 29 days. Almost all peoples using the lunar (synodic) month observe this principle of reckoning time. We know that the lunar month is actually 29.530588 days ($29^d\ 12^h\ 44^m\ 2^s.8$); consequently, the *lunar year* of 12 lunar months amounts to 354.367056 days ($354^d\ 8^h\ 48^m\ 34^s$).

The solar day and the lunation appear to have been the sole units used in recording time in the pre-agricultural stage. Later, twelve consecutive lunations were counted as a lunar year. Such a calendar, patterned exclusively after the movements of the moon in relation to the solar day, is known as a *lunar calendar*. This lunar calendar has been the cause of some difficult problems in calendar making.

Since the lunar month does not contain an integral number of days, or exact half-days, it became imperative to devise an arrangement that would furnish a practical and consistent instrument of measurement. Naturally it had to be done by some system of intercalation or adaptation. This resulted in the counting of one month of 30 days and the next of 29 days. These two months were alternated in the reckoning of the lunar year.

Let us first consider the use of the alternating 30- and 29-day months in the lunar calendar. Two such months, comprising 59 days, would, in reality, fall short of the two lunations by 0.061176 of a day (1^h 28^m and about 6^s). This deficiency would amount to one day in 32.70 lunar months and could be corrected by intercalating a day every thirty-second month of the alternating 30- and 29-day months. Thus, if the first month were of 30 days, the second of 29, the third of 30, the thirty-first month of 30 days would be followed by the thirty-second month of 30 days instead of the usual 29. By such intercalation the lunar year could be made to harmonize with a lunation.

Let us now consider how lunar months fit a cycle of lunar years. If the lunar year is reckoned as 354 days, it leaves 0.367056 of a day unaccounted for; this length of time accumulates to about 1.1012 days in three lunar years, or to about 11.012 days in a cycle of thirty lunar years. The fractional excess of 0.012 of a day would amount to one day in 83⅓ cycles of thirty lunar years, or one day in 2,500 lunar years, and for practical purposes can be ignored. Therefore, if eleven days were intercalated in the course of thirty lunar years of 354 days each, we would have a fairly accurate and consistent lunar standard. By such intercalation is the regularity and sequence of the lunation assured in a lunar calendar. This method of intercalation was utilized by early nomadic Arabs in their lunar calendar, and was later adopted by Mohammed.

Because the lunar year bears no relation to the seasons, the intercalations can be made at convenient periods without conflict or complications. Thus an adequate purely lunar standard can be devised with little trouble. The Mohammedan Calendar (see pp. 49 ff.) is a calendar of this type. In this kind of calendar, because the lunar year is nearly 11 days shorter than the solar year, the seasons drift from year to year and, in the course of thirty-four lunar years, spring may begin in every single month of the lunar year. The lunar calendar is therefore highly impractical for agricultural purposes. Because the seasons need to be identified with precision and because they constitute a basic guide for economic activity in modern life, the use of a lunar calendar would be a distinct handicap.

THE SOLAR CALENDAR

A calendar built exclusively upon the earth's movement around the sun, with the solar day and the solar (tropical) year as component parts, is called a *solar calendar*. In this calendar the lengths of the month are *arbitrarily* fixed and bear no relation to the moon or its phases. The solar year usually revolves on one or more of four pivots, namely, the two solstices and the two equinoxes.

The solar year (365.2422 days) is $365^{d}\ 5^{h}\ 48^{m}\ 46^{s}$ in length. To make sure that the seasons recur approximately on a fixed day, or, more explicitly, that the vernal equinox occurs on March 21, intercalation is necessary. For that reason some provision for the fractional part of the year, namely $0^{d}.2422$, must be made. This fractional time accumulates to $0^{d}.9688$ ($23^{h}\ 15^{m}\ 4^{s}$), or nearly a day every four years. Therefore, the addition of an extra day after every four years would cause the season to advance about 0.0312 day ($44^{m}\ 56^{s}$) every four years, or 0.0078 day (11^{m} and 14^{s}) per year. In one hundred years this excess would add up to 0.78 day ($18^{h}\ 43^{m}\ 12^{s}$). In four hundred years the seasons would occur about 3.12 days ($3^{d}\ 2^{h}\ 52^{m}\ 48^{s}$) earlier, and the vernal equinox would fall on March 18 instead of March 21. In order to align the seasons with the equinoxes and solstices, besides adding an extra day every four years, three days would have to be dropped every four hundred years. This principle was embodied in the Gregorian reform of the Julian Calendar. (See Chapter III, p. 71 ff.) This Gregorian adjustment still causes an excess of $0.^{d}0003$ (26 seconds) in each solar year, which amounts to about a day in 3,323 years. For purposes of our contemporary calendar this error can be ignored.

The ancient Mayan, Egyptian, Hindu (*Vikrama* Calendar), and our Gregorian Calendar belong to this category—the solar calendar.

THE LUNI-SOLAR CALENDAR

Most calendars in use today are neither purely solar nor exclusively lunar, but are compounded of both forms. Such calendars are called *luni-solar.* The ancient Chinese, Hindu (Saka Calendar), Babylonian, Hebrew, and Greek calendars were of this character. In them were incorporated heritages of diverse origins, the attachments to parochial loyalties, and the tyranny of set habits and time-honored conventions.

The term *luni-solar* implies the relating of the lunar month to the tropical (solar) year in such a way that the identities of both are retained. Thus, in a luni-solar calendar, the year of 12 lunar months, comprising about 354⅓ days, is harmonized with the solar year of about 365¼ days by inserting at the rate of about 11 extra days per lunar year. This is usually done by intercalating a thirteenth lunar month every second or third year.

Most ancient peoples used lunations to measure the passage of time. However, as they settled into an agrarian culture, their agricultural needs and related festivities compelled them to mark precisely the recurrence of the seasons. This need for forecasting the agricultural seasons necessitated intercalations to link the lunar month and the solar year in such a manner that the plowing season would occur at approximately the same time each year. As pointed out earlier, farmers in most agricultural countries have identified the beginning and the ending of the seasons with some natural phenomenon and, in particular, have correlated them with the solstices and equinoxes as well as with the annual risings and settings of the fixed stars.

Calendar makers have attempted numerous ways of arriving at a happy balance between a lunation of 29.530588 days and a solar year of 365.2422 days. But the synodic revolution of the moon around the earth and the tropical revolution of the earth around the sun do not find a common divisor in the day. Even the day, as previously noted, does not fit integrally with either the lunation or the tropical year.

This basic triangular conflict complicates the problems of the calendar tremendously, and makes a consistent compromise really difficult. The situation is made still more complex by a fourth element of time measurement, which plays an important role in our social life, namely, the week.

THE WEEK—AN ARBITRARY DEVICE

Unlike the lunar month and the solar year, the week is not a natural unit of time reckoning. It is basically an arbitrary device dictated by social necessity, and has come to be an intermediate unit between the day and the month. The seven-day week has been so interwoven with a variety of cultures that its origin continues to be veiled in the mist of antiquity. It has, however, been known in India, Babylonia, and Palestine from earliest days.

THEORIES OF THE WEEK'S ORIGIN

One theory of the week's origin is that when, in the course of human development, there was a surplus of goods among neighbors and a desire to exchange these goods, a market place was agreed upon and a day for barter and commerce was set aside. On that fixed market-day people from neighboring communities congregated at a central location for the exchange of their surplus goods, and the market-day became a very important social frame of time-reference. In some cultures the day of marketing was also the day of rest; it was considered inviolable, and therefore not to be polluted by the usual routine of daily exertions. The period between two market-days evolved into the broad concept of a week. The market-week followed a continuous and recurrent cycle which ran from week to week, year after year. Thus a market-week of either three, four, or five days, or their multiples of six, eight, or ten days, has been known to exist at some time in different parts of the world.[3] In ancient Rome *Nudinae,* meaning the ninth day, was designated as the regular market-day. So the Romans observed an eight-day week. The Egyptians observed a ten-day week, which was later adopted by the Greeks and appropriately called a *decade.*

Some peoples had a recurrent day of rest given exclusively to recreation and festivities. Among others the day of rest was a day of abstention and worship, dedicated to fasting and prayer, from which all secular activities were ruled out. The Babylonians observed such a holiday and called their seventh day *Shabattu,* or day of rest. The Assyrian weekly resting day was called the *sabbat,* and the Hebrew, *Sabboth,* of which *Sabbath* is the English version. Thus we received the Biblical injunction, "Six days shall work be done, but on the seventh day there shall be to you an holy day, a sabbath of rest to the Lord: whosoever doeth work therein shall be put to death."[4]

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[3] H. Webster, *Rest Days,* pp. 106 ff. The Macmillan Company, New York, 1916.

There is another theory, advanced by Dr. M. Esther Harding and supported by anthropological research, that a ritual day of rest was observed in ancient times at the moon's quarters, and that this holy day grew out of taboos relating to woman's biological period and subsequently to the moon goddess to whom women were supposed at this time to be magically related. In ancient Babylonia, the moon goddess *Ishtar* ruled over man's destiny on earth and her changes were therefore recorded in the calendar. Her regular waxings and wanings were considered to affect woman's own monthly cycles.

At the full moon the Babylonian priests caused the day to be observed as a ritual or holy one dedicated to the goddess *Ishtar.* This holy day was known by the Babylonian word *shabattu* or "evil day." It was circumscribed by taboos which were meant to protect all the people from Ishtar's "evil" power when she was full. And interestingly enough these were the same taboos which rigidly controlled a woman's activities during her monthly period, when contact with her was thought to be dangerous and contaminating.

These taboos have been found among a variety of cultures.[5] To break the taboo was believed to bring evil upon one or all, and among some people transgression was punishable by death.

Dr. Harding says, "The word *shabattu* or *sabattu* comes from 'Sa-bat' and means 'Heart-rest'; it is the day of rest which the moon takes when full, for at that time it is neither increasing nor decreasing. On this day, which is the direct forerunner of the

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[4] Exodus 35:2.

[5] Robert Briffault. *The Mothers,* Vol. II, pp. 365–439. The Macmillan Company, New York, 1927.

Sabbath, it was considered unlucky to do any work or to eat cooked food or to go on a journey. . . . The Sabbath was at first observed only once a month. The records state variously that this was at full moon or at new moon; but later it was kept at both new and full moon and later still at each quarter of the moon's phases. These days were called *ûmu limnu,* evil day. Their dates fell on the 7th, the 14th, the 21st and 28th days of the month, for when time was reckoned by the moon the months were of equal length, namely, twenty-eight days, corresponding to the cycle of the moon." [6]

Dr. Harding observes, further, that there is a direct relationship between the Babylonian and the Hebrew Sabbaths and probably also a link between them and the Egyptian lunar taboo days. It may be strange to many to realize that the prohibitions in the observance of the Sabbath, in their remote beginnings, were taboos related to the belief that the moon was a woman who experienced the fullness of her monthly cycle.

However plausible this theory of the week being related to the moon may appear, the fact remains that the discrepancy between four weeks and a lunation amounts to a bit more than 1½ days. This difference is too obvious to lend the theory any great validity. Other outstanding authorities contend that there is no real proof for the lunar origin of the week.[7] On the contrary, M. P. Nilsson holds that the phases of the moon were arranged to conform to the septenary scheme, wherein many human activities were related to the numeral seven or the multiples thereof.

THE MAGICAL SEVEN

The numeral seven has been considered lucky in many cultures. The seven cavities in the animal skull are considered by some to have suggested 7 as a ritual number. It is believed by others, however, that this concept stems from the star lore that was extensively used in astrological computations.

Because early man believed that the heavenly bodies exerted both benevolent and malevolent influences upon human affairs, he referred to them in guiding his activities and enterprises. He observed the seven stars in the cluster of the Pleiades in the northern sky, the constellation of seven stars in the Great Bear and the Little Bear, the seven stars that comprised the Crown, and the seven stars that formed Hercules. Astrologers made extensive use of these stars in their interpretations. Some authorities hold that from such an astrological background we inherited the idea of the sacred seven, which is widely prevalent in seemingly isolated cultures of the world.

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[6] M. Esther Harding. *Woman's Mysteries,* p. 52. Longmans, Green and Company, New York, 1935.

[7] M. P. Nilsson, *Primitive Time Reckoning,* pp. 332 ff. Lund, Sweden, 1920.

In any event, it is well known that early man expressed numerous concepts in groups of seven. Thus we have the seven virtues and the seven vices, the seven prayers and the seven psalms, the seven wise men and the seven Bibles, the seven seas, and the seven notes in the musical scale.

THE SEPTENARY WEEK

An interesting remnant of the magical seven of earlier days is seen in our seven weekday names, which were at one time related to the Seven Ages of Man, a concept that is still widely prevalent in contemporary India. Infancy was related to the fertilizing goddess Moon, adolescence to Venus, manhood to Mars, middle age to Jupiter, and old age to Saturn—a malignant star that foreboded death. Our days of the week are named after these seven celestial wanderers (the ancients considered the sun and the moon as planets). The following list gives the parallel names for days of the week in Saxon, Spanish, Latin, Sanskrit, and Babylonian.

TABLE IV

DAYS OF THE WEEK IN DIFFERENT LANGUAGES

Days Named After	*Saxon*	*Spanish*	*Latin*	*Sanskrit*	*Babylonian*
Sun	Sun's Day	Domingo	Dies** Solis	Ravi vara**	Shamash
Moon	Moon's Day	Lunes	Dies Lunae	Soma vara	Sin
Mars	Tiw's Day	Martes	Dies Martis	Mangala vara	Nergal
Mercury	Woden's Day	Miercoles	Dies Mercurii	Budha vara	Nabu
Jupiter*	Thor's Day	Jueves	Dies Jovis	Brihaspati vara	Marduk
Venus	Frigg's Day	Viernes	Dies Veneris	Shukra vara	Ishtar
Saturn	Saterne's Day	Sabado	Dies Saturni	Sanischara vara	Ninib

* Jupiter is the compounded version of Jovis (Jove) and Pater (father).

** The Sanskrit word *Vara* and the Latin word *Dies* mean "day."

In Table IV the nomenclature and the sequence of the days of the week are shown to be so identical that it would not be unfair to conclude that the seven-day week had a common origin, despite the diversity of locale where it is found in practice today.

Some authorities definitely ascribe the origin of the seven-day week to Babylonia, whence, they say, the practice spread east to Asia and west to Africa and Europe.[8] The number seven was peculiarly stressed in Hebraic lore. The seventh day, seventh month, seventh year, and the year following seven times seven, the Jubilee Year, were designated as periods of rest.[9]

The seven-day week was introduced into Europe by Constantine the Great, with the Christian innovation of Sunday replacing Saturday as the Lord's Day in A.D. 321. Constantine is supposed to have adopted it primarily to afford his soldiers a free day on which to attend church services.

ADAPTING THE WEEK TO MONTH AND SOLAR YEAR

We have seen the triangular conflict arising out of attempts to synchronize the lunar month, the solar year, and the day. With the week introduced as a fourth factor, the problem assumes cumulative complexity. There are 4.2186 weeks in a lunar month, and 52.1774 weeks in a solar year. This mathematical relationship precludes the possibility of synchronizing the week with the lunar month or the solar year in terms of whole numbers. The number 365 is divisible integrally by neither 7 nor 12. In the design of a calendar, if the number of weeks in a month is to be an integer, the number of days in a month, of necessity, should be a multiple of 7. If that requirement is met, the months cannot possibly retain their present numerical pattern. On the other hand, if the months retain their current status, there cannot possibly be a complete number of weeks in any month, except February, which has 28 days. And since the number of days in a lunar month, when divided by 7, leaves a remainder, it is impossible to reconcile the week with the lunar month without resorting to the device of occasionally dropping out this remainder from the computation.

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[8] James Hastings, *Encyclopedia of Religion and Ethics*, Vol. XII, pp. 103 ff. See "Sunday." Charles Scribner's Sons, New York, 1911.

[9] Leviticus 25:2, 3, 4, 8, 9, 10, 11.

The problem resolves itself into an attempt to eliminate from the calendar the use of either the week or the month, or to arrive at a compromise which means a basic change in the structure of our months as at present constituted. The same conflict and compromise also apply to the week and to the solar year. The solar year is not an exact multiple of the week but contains an excess of one day in common years, and two days in leap years.[10] If the week and the solar year are to be harmonized, some means must be found for dropping off the excess of 1.2422 days from the solar year (365.2422 days) to provide a rounded year of 52 weeks or 364 days. This could be achieved by excluding the three hundred sixty-fifth day of all years and the three hundred sixty-sixth day of leap years from the calculations of the weeks, the months, and the year, and giving them individualized identity such as "Year-End Day" and "Leap Year Day."[11] Such days, of course, would not be associated with any day of the week nor with any date. They would be called *stabilizing days.* Even if such an arrangement were to be made, the 364 days could not be reconciled with the 12 months without providing for months of unequal duration. Because 364 can be factorized into 4, 7, and 13, we have to take Hobson's choice, namely, a month of 28 days, if we want to retain the week and have all months of equal duration. According to this arrangement we would have a year of 364 days, 52 weeks, or 13 months.

Since 12 is not a factor of 364, the only way to divide 364 into 12 months would be to make the months unequal. This could best be done by dividing 364 into four quarters of 91 days each, and dividing each quarter into three months of 31, 30, and 30 days. Thus there would be a year of 12 months—eight months of 30 days and four months of 31 days. There is no conceivable way by which we can get 12 months of equal duration having an integral number of weeks and still adding up to 364 days. The retention of 12 months compels the necessity of a minimum of two different standards of months.

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[10] The figure 365 is divisible only by 5 and 73. It does not permit a division into 12 months of equal length, nor into an even number of weeks.

[11] See Chapter IV, pp. 87 ff.

ADAPTING THE SYNODIC (LUNAR) MONTH TO THE SOLAR YEAR

There are approximately 12.3683 lunations in a solar year of 365.2422 days; hence a lunar year of 354.3670 days (12 lunations) is approximately 11 days shorter than a solar year. This difference of 11 days is transmitted in the calculations of the seasons when time is reckoned by purely lunar months and a lunar year. On the basis of the lunar year, the seasons drift about 11 days every succeeding year. Assume that the lunar year begins on the vernal equinox (March 21) of any given year; the following year (the lunar new year) will begin on March 10; and a year later on February 27, if it is a common year, and on February 28, if it is a leap year, and so on. In about 33½ solar years the new year would have occurred in every month of the year (see Mohammedan Calendar, pp. 49 ff.) and would once again return to approximately its starting point—the vernal equinox. How to eliminate this drift and still retain the lunar month to forecast the seasons is therefore the problem.

In early times agricultural operations were inseparably bound to gods and goddesses. The notion then prevalent was that the processes of nature were influenced by the whims of gods. To ancient peoples it was imperative that the gods be humored at the appropriate time to bring about desired rains for the crops and to have the dry season for the ripening and reaping of the harvest. This belief resulted in the accurate fixing of time and calendar making—a social function of first-rate importance. Because most early calendars were measured by lunations, and because most crop ceremonials and religious rites were related to the seasons, harmonizing the lunar month with the solar year became a basic problem of the priests from the time man first embarked on agriculture.

In the course of history, the priests of ancient China, India, Babylonia, Palestine, and Greece tried their hand at fitting the lunar month into the solar year and found diverse solutions based on the same fundamental principle of intercalation. The purpose of this intercalation was to achieve two results: first, to maintain the continuity of the lunar month as a fixed standard of time measurement; second, to have the seasons fall in as nearly the same months as possible year after year. In other words, the problem was to find the length of time between successive coincident positions of the earth and the moon in relation to the sun and to determine how much time elapsed before the same phenomenon occurred again. The underlying idea was to equate an integral number of lunations with an integral number of solar years and thereby ensure an unbreakable chain of lunar months and solar years.

To maintain such continuity it was imperative that the intercalation be a *full* lunar month and not a fraction of it. The problem then became one of inserting the intercalary month at the appropriate time in the correct lunar year in such a manner as to make the most approximate correspondence of seasons from year to year. Such an intercalation made some luni-solar years of 384 days (13 lunations), in contrast to the normal lunar year of 354 days (12 lunations). A luni-solar year containing 13 lunar months is called an *embolismic year.* Determination of the embolismic year constituted the bane of calendar makers of ancient times, as it would indeed today if the design of a new luni-solar calendar were undertaken.

Our primitive ancestors probably first counted 13 lunations to the year. As their knowledge grew and as they devised more accurate methods of recording their reckonings, they must have realized that 13 lunations exceeded the solar year a trifle too much. The problem then was to find a whole number of lunations that would be equal to an integral number of solar years. Therefore they must have made observations over a very long period to determine when the two coincided.

An important element in establishing luni-solar relationship was the phenomenon of the eclipses. Eclipses were regarded in most early cultures with forebodings, and it was almost universally believed that they were caused by demons who devour the luminary. To relieve the luminary, expiations were deemed necessary.[12] Among the ancient Chinese,[13] Hindus, and Babylonians, eclipses played peculiarly important roles long before the Christian Era, because religious rites were intimately related to them. In 2159 B.C. the emperor Chung K'ang executed the astronomers royal Hi and Ho for their failure to predict an eclipse of the sun. The cycles of the eclipses have been so exact that the Hindus, for centuries before the Christian Era, had been able to forecast eclipses in advance to enable the devout to make pilgrimages to distant holy places, when the sun or the moon would be stigmatized by the demons. The astronomical contributions of ancient Babylonians also were particularly significant.

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[12] James Hastings, *Encyclopedia of Religion and Ethics,* Vol. X, pp. 368–369. Charles Scribner's Sons, New York, 1911.

[13] J. Bredon and I. Mitrophanow, *The Moon Year,* p. 8. Kelly & Walsh, Shanghai, 1927.

The Babylonians had determined the precession of the equinoxes and were familiar with the nature and causes of eclipses. Babylonian astronomers are credited with the discovery that there was a cycle of the eclipses, which repeated itself after every 223 lunations. They called it a *Saros,* meaning "repetition," a distinctly descriptive designation. This astronomical cycle consists of 6585.3229 days, and is approximately 11 days in excess of 18 solar years. The Babylonians knew that during the course of a *Saros* there occur 29 lunar and 41 solar eclipses which are repeated from cycle to cycle.[14]

In the Babylonian hierarchy the moon occupied the loftiest position and as a consequence the moon dominated the calendar. About two millenniums before the birth of Christ, the Babylonian king Hammurabi is known to have issued, on the advice of his astronomer-priests, an edict for the insertion of an intercalary month.[15] In the sixth century B.C. Nabu-rimanu (Naburianos), the Babylonian astronomer, is reputed to have determined the value of a synodic month as 29.530614 days ($29^d\ 12^h\ 44^m\ 5^s$), and of the tropical year as 365.2609 days ($365^d\ 6^h\ 15^m\ 41^s.7$).[16] These differ from our current values by 2.2 seconds for the synodic month, and by 26 minutes and 54.6 seconds for the tropical year. This knowledge makes us appreciate that the ancients were capable of making amazingly accurate observations with extremely crude instruments.

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[14] Alexander Del Mar, *The Worship of Augustus Caesar,* Chap. VIII, pp. 237 ff. Cambridge Encyclopedia Company, New York, 1900.

[15] L. W. King, *The Letters and Inscriptions of Hammurabi,* Vol. 3, pp. 12-13. Luzac & Company, London, 1900.

[16] J. K. Fotheringham, *Nautical Almanac for 1935,* p. 756. H. M. Stationery Office, London, 1934.

It was during the time of Nabu-rimanu that the 8-year cycle was in use in Babylonia. In this cycle 8 solar years were made to equate with 99 lunations. Actually 8 lunar years add up to 2834.94 days and fall 87 days short of 8 solar years. So they intercalated 3 lunations in 8 years and reckoned 5 years at 12 lunations and 3 years at 13 lunations. The Jews also made identical use of this cycle. This cycle was later known among the Greeks as *Octaeteris.*

Later, the Babylonians discovered that a slightly more accurate cycle than the 8-year solar cycle was an 11-year solar cycle. In this cycle the difference between 11 solar years and 136 lunations amounted to about 1.5 days. However, on the basis of solar and lunar years, the difference amounted to 119.63 days. To compensate for this discrepancy and to keep their lunar months and solar year coordinated, they intercalated 4 lunar months in their calendar. Thus in a cycle of 11 years they observed 7 years with 12 synodic months and 4 years with 13 synodic months. In due course of time, realizing that the 11-year cycle did not possess the desired accuracy, they sought a new cycle. About the fifth century B.C. they expounded a 19-year cycle. This innovation is credited by some authorities to the Athenian astronomer Meton and has been called after him—the *Metonic cycle.* In 432 B.C. Meton stated that 235 lunations were very nearly equal to 19 solar years—when the earth and moon return approximately to the same position in relation to the sun as they had occupied 19 solar years earlier. Thus in approximately 19 solar years, or 235 lunations, a coincident lunar and solar phenomenon repeats itself. The difference between 19 lunar and 19 solar years amounts to 206.63 days, or 6.997 (about 7) lunations. In other words 7 lunar months must be intercalated during the course of 19 lunar years to synchronize 235 lunar months with 19 solar years. Such an intercalation would therefore enable as approximate a recurrence as can possibly be feasible with the observance of a lunar month. This cycle of 19 years was also known to the ancient Chinese, Hindus, Jews, and Greeks, and they have all employed it for intercalary purposes in their luni-solar calendars. The Chinese are known to have used this cycle as early as 2269 B.C.[17]

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[17] W. Hales, *A New Analysis of Chronology and Geography,* Vol. I, p. 37. C. J. G. & F. Rivington, London, 1830.

The practice of inserting the intercalated month, however, varies among different peoples. The intercalated or the thirteenth month of the embolismic year is inserted either in the middle or at the end of the year. Practically all present-day calendars that follow a luni-solar system use the 19-year solar cycle, and during that period intercalate seven lunar months.

Such an intercalation became inevitable because of the irreconcilable character of different time units. No two of them, the week, the month, or the year, are mathematically compatible, nor can they be conveniently integrated; and the attempt to reconcile all three of them to obtain a logical, uniform, consistent, and sequential standard becomes an absurdity of the first magnitude. Three variables cannot one constant make, especially when all are to be hitched to the seasons. How very accommodating the earth would be, were it to rotate on its axis exactly 360 times in making one revolution around the sun! And if the moon, too, were to accommodate us and follow this salutary example by regulating its speed so that it made one complete circuit around the earth in exactly thirty days, we could indeed have a perfect calendar, a month of exactly thirty days and a year of twelve equal months. The two units of time measurement, the month and the year, would then be in perfect unison. However, even then the week would still be beyond the pale of synchronization.

Such, then, are the vagaries of reconciling the irreconcilables!

CHAPTER III

BASIC CALENDAR PATTERNS

"If the contemplation of the universe for its own sake were the function of science, then science as we know it now would never have existed, for the most elementary reading of the history of science shows that both the drive which led to scientific discoveries and the means by which those discoveries were made were material needs and material instruments."—J. D. BERNAL[1]

EXAMPLES OF BASIC TYPES

IN ORDER to step from theory to practice, let us see how the three basic calendars—the lunar, the solar, and the luni-solar—have been used by different peoples at different times in different cultures. We will first consider the most ancient type which is now found in use in the Moslem world.

THE MOHAMMEDAN CALENDAR: A LUNAR CALENDAR

The earliest calendars are presumed to have been related to the moon's waxing and waning. A purely lunar calendar follows the lunations to measure time and therefore does not permit a correlation with the solar year; consequently, it is entirely divorced from the seasons. The adoption of a purely lunar standard may be ascribed to two probable causes: (1) the extreme simplicity of reckoning; (2) the nomadic character of the people who live in regions where the seasons are not sharply defined. Most people who reckoned time by the moon counted their day from sunset to sunset, and began the new month and their new year with the new moon.

The nomadic Arabs fit this pattern. Their calendar was entirely governed by the moon from month to month and from year to year. The Mohammedan Calendar is an outgrowth from the culture of the nomadic Arabs and is conspicuous in being the lunar calendar most widely used in the twentieth century. Moslems the world over use the purely lunar calendar for their religious observances. It is made up of 12 lunar months of 30 and 29 days, alternately, the odd months of the year being 30 days and the even months 29 days.

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[1] J. D. Bernal, *The Social Function of Science*, pp. 5, 6. The Macmillan Company, New York, 1939.

During the time of Mohammed (seventh century) a luni-solar calendar was in use among some Arabs, while the Bedouins are known to have followed a purely lunar calendar. Since the calendar had been a potent instrument in the hands of priests who exploited it for their personal aggrandizement, the Koran forbade intercalation. Mohammed suppressed the usage of the luni-solar calendar, forbade his followers to use the month Nasi (the intercalary month), and decreed the observance of a strictly lunar year of 12 months. Since then the crescent has symbolized the *Faith,* and the moon has been the *sole* measurer of the Moslem Calendar.

This unique lunar calendar was not established until ten years after Mohammed's flight from Mecca.

The Moslem era commemorates the *Hijra* (meaning the "flight for the sake of God") and so is called *Anno Hijra* (A.H.), meaning "in the year of the flight." The A.H. era was introduced by Khalif Umar in A.D. 638–639 after the death of the Prophet (Mohammed). This era began on the first day of Muharram (first month of the year) with a new moon on a Friday and corresponds to July 16, A.D. 622. Since then Friday has been a holy day for the Moslem, just as Saturday is for the Jew, and Sunday for the Christian.

During the calendar year A.D. 1943 the Moslem world celebrated two legitimate New Year Days—one on January 8, which was equivalent to Muharram 1, A.H. 1362, and the other on December 28, which ushered in the year A.H. 1363. This occurrence of a double Moslem New Year in one Gregorian Calendar year is not unique. It occurs nearly every 33 solar years, because 33 solar years (12,053 days) approximate 34 lunar years (12,048 days). A person considered to be thirty-four years old according to Moslem calculations is, in terms of our solar reckoning (Gregorian Calendar), really thirty-three years old, and during that period will have celebrated his birthdays through every month of the Gregorian year, and in every season of the year.

TABLE V. AN ANALYSIS OF THE MOHAMMEDAN CALENDAR

(46th Cycle = 10,631 Days)

Number of Cyclic Year	*A.H. (Anno Hijra) Year*	*Days in Year*	*Total Cumulative Days*	*New Year A.D. Date Begins on (Muharram 1)*	*Annual Retrogression in Days*
1	1351	354	354	May 7, 1932	11
2L	1352	355	709	April 26, 1933	10
3	1353	354	1063	April 16, 1934	11
4	1354	354	1417	April 5, 1935	12
5L	1355	355	1772	March 24, 1936	10
6	1356	354	2126	March 14, 1937	11
7L	1357	355	2481	March 3, 1938	10
8	1358	354	2835	Feb. 21, 1939	11
9	1359	354	3189	Feb. 10, 1940	12
10L	1360	355	3544	Jan. 29, 1941	10
11	1361	354	3898	Jan. 19, 1942	11
12	1362	354	4252	Jan. 8, 1943	11
13L	1363	355	4607	Dec. 28, 1943	11
14	1364	354	4961	Dec. 17, 1944	11
15	1365	354	5315	Dec. 6, 1945	11
16L	1366	355	5670	Nov. 25, 1946	10
17	1367	354	6024	Nov. 15, 1947	12
18L	1368	355	6379	Nov. 3, 1948	10
19	1369	354	6733	Oct. 24, 1949	11
20	1370	354	7087	Oct. 13, 1950	11
21L	1371	355	7442	Oct. 2, 1951	11
22	1372	354	7796	Sept. 21, 1952	11
23	1373	354	8150	Sept. 10, 1953	11
24L	1374	355	8505	Aug. 30, 1954	10
25	1375	354	8859	Aug. 20, 1955	12
26L	1376	355	9214	Aug. 8, 1956	10
27	1377	354	9568	July 29, 1957	11
28	1378	354	9922	July 18, 1958	11
29L	1379	355	10277	July 7, 1959	11
30	1380	354	10631	June 26, 1960	11

46th Cycle Ends and 47th Cycle Begins

1	1381	354	354	June 15, 1961	11
2L	1382	355	709	June 4, 1962	10
3	1383	354	1063	May 25, 1963	11
4	1384	354	1417	May 14, 1964	

L = lunar leap year (*Kabisah*) when the 30th day of the last (twelfth) month, which has normally 29 days, constitutes the 355th day of the year. The other years have exactly 354 days.

The Arabian astronomers calculated the mean length of a lunation as $29^{d}.530556$ ($29^{d}\ 12^{h}\ 44^{m}$). This amounts to 354.366672 days for a lunar year of 12 lunations. Actually, a lunar year of 12 months of 30 and 29 days, alternately, comes to exactly 354 days, so that the uncared-for fraction of 0.366672 adds up to a day in 2.7272 lunar years, or to 11.0001 days in 30 years. To keep their lunar months consistent and regular, the Arabian astronomers decided upon a lunar cycle of 30 years and intercalated 11 days in that duration. Thus they had 11 Sanah Kabisah (leap-lunar) years of 355 days, and 19 Sanah Basitah (common-lunar) years of 354 days. (See Table V.) During common years there are 6 months each of 29 and 30 days. In leap years a day is added to the twelfth month, making it 30 days instead of the usual 29, so that there are 7 months of 30 days and 5 months of 29 days. With this understanding the Arabs formulated the following specifications for their calendar:

1. A cycle of 30 lunar years.
2. Nineteen common-lunar years, each of 354 days.
3. Eleven leap-lunar years, each of 355 days.
4. The years 2, 5, 7, 10, 13, 16, 18, 21, 24, 26, and 29 of the 30-year cycle to be leap-lunar years.
5. The years 1, 3, 4, 6, 8, 9, 11, 12, 14, 15, 17, 19, 20, 22, 23, 25, 27, 28, and 30 to be common-lunar years.

Since a lunar year is approximately 10.8752 days shorter than the solar year, the Moslem New Year reckoning retrogresses from the Gregorian dates by 12, 11, or 10 days. In general, the retrogression near a Gregorian leap year is 12 days, after a Basitah (common-lunar) year 11 days, and after a Kabisah (leap-lunar) year 10 days. This causes the Hijra year to occur 10, 11, or 12 days earlier from year to year. This retrogression also causes the seasons to fall, at some time or another, in each and every month of the Moslem Calendar. Thus in about thirty-four Moslem years there would be only thirty-three occurrences of the seasons.

However simple the Moslem Calendar may be, it is singularly impractical for a people dependent on the seasons for their livelihood and in need of precise knowledge to determine the seasons' occurrence.

THE EGYPTIAN CALENDAR: A SOLAR CALENDAR

Almost all the early calendars known to man began with the moon and the lunar year. Knowledge of the lunar year is believed to have preceded that of the solar year. This is as true of Egypt as it is of Greece, Babylonia, India, and China. The Egyptian 30-day month is a vestige of the earlier lunar orientation. The Egyptians used the symbol of the crescent moon as a hieroglyph for "month." It was not until the early Egyptians correlated the heliacal [2] rising of the Dog Star (Sirius) with the annual flood of the Nile that they were able to dispense with the moon as the measurer of time. However, once the Egyptians were able to establish the length of the sidereal year and the annual flood became their frame of reference for time, the moon definitely disappeared from their reckoning as well as from their calendrical sky. These events finally led to the formation of the first known solar calendar. According to the Egyptologist James Henry Breasted, the Egyptian Calendar began in 4236 B.C.

The almost rainless land of Egypt owed its usefulness for agricultural purposes exclusively to the annual floods of the Nile, which always began in the latitude of contemporary Cairo (Pe-Ra [3]) approximately on July 19. The flooding of the Nile was a vital factor in the life of the Egyptian, for upon it depended his principal economic activities, including the growing of his sustenance. He relied on the flood for irrigation and cultivation. The ebb and flow of the Nile influenced every detail of Egyptian ritual and religion, myths and morals, thought and theology, festivals and farming.[4] So, early in the life of Egypt the flood symbolized the beginning of the cycle of life and became a point of reference that was as basic as life itself. Thus, the Nile in more ways than one constituted a gigantic water clock.

A unique natural phenomenon, which no doubt had repercussions in the intellectual development of the race in general, and of the calendar makers in particular, played an important part in the determination of the sidereal year in Egypt. This phenomenon was the concurrence of the rising of the Nile and of Sirius, which was observed as a joint undertaking of the heavenly and earthly gods, and was celebrated throughout the countryside as the beginning of a new year—the first day of the first month Thoth.

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[2] *Heliacal* means relating to the sun and hence means "easternly." In Egypt, on July 19, the Dog Star preceded the sun in rising by a few minutes at approximately the same position on the eastern horizon.

[3] *Pe-Ra,* the "Abode of Sun," also known by the Hebrew name *Beth-shemesh,* and the Greek *Heliopolis.*

[4] J. G. Frazer, "Adonis Attis Osiris." *The Golden Bough: A Study in Magic and Religion,* 3rd ed., Part IV, Vol. II, Chap. III. The Macmillan Company, New York, 1935.

Since agricultural activity began with the very first day of the annual flood, this occasion soon came to be recognized as a natural opening day of a new year. The agricultural cycle in Egypt consisted of three seasons of four months each; namely, Aket the flood, Proyet the spring (sowing), and Shomy the harvest.[5] Thus the calendar was correlated with agricultural pursuits and was devised to fit in with the conspicuous economic needs and social activities of a rural people.

A vestige of the lunar month is also found in the 30-day month of the Egyptian solar year. This year consisted of 12 months of 30 days each with five supplementary days added at the end of the twelfth month, thereby making a year of 365 days. The extra five days in the Egyptian year were known as *epagomenal* days and were dedicated to the gods Osiris, Horus, Set, Isis, and Nepthys.[6] The calendar used by the Coptic Church still follows this ancient Egyptian pattern.

This civil year of 365 days was deeply entrenched in the hands of priests, who refused to make adjustments to agree with the solar year; consequently, in time the Egyptian Calendar began to drift away from the natural seasons. Because the civil year was about one-fourth of a day shorter than the solar year, in four years, according to calculations, the first of Thoth (New Year's Day) occurred the day after the heliacal rising of Sirius; in eight years it drifted away two days; in twelve years three days; and so on. After a period of 1,461 years of 365 days each, the first of Thoth occurred once more with the coincident rising of Sirius and of the

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[5] H. E. Winlock, "The Origin of the Ancient Egyptian Calendar." *American Philosophical Society Proceedings*, Vol. 83, No. 3, pp. 447 ff. 1940.

[6] J. G. Frazer, "Adonis Attis Osiris." *The Golden Bough: A Study in Magic and Religion*, 3rd ed., Part IV, Vol. II, pp. 6 ff. The Macmillan Company, New York, 1935.

Nile. In a cycle of 1,461 years the first of Thoth, along with the seasons, had drifted over the entire civil calendar from one extreme to another and occupied every one of the 365 days of the calendar year. And in these 1,461 years the star Sirius and the river Nile rose only 1,460 times. This made the astronomers realize that 1,461 years of 365 days were equal to 1,460 years of 365¼ days. A knowledge of this disparity later proved a boon to the development of our solar calendar. It was through this discrepancy that the Egyptian astronomers recognized the true length of the solar year to be 365¼ days. The astronomers attempted to introduce necessary reforms to bring the calendar up to date. But the authoritarian priests were powerfully established and, considering the calendar as their peculiarly private preserve, resented any trespass. The struggle for change persisted for centuries, until finally, in 238 B.C., by the Decree of Canopus,[7] of King Ptolemy III, Euergetes, the erratic quality of the calendar was eliminated. The decree provided for the intercalation of a day at the end of every four years. This intercalation resulted in a leap year of 366 days, and so the year came to be recognized as averaging 365.25 days. The calendar then assumed a decidedly more accurate and stable form, and marked the beginning of our present solar calendar.

Since the Egyptians depended on the heliacal rising of Sirius for their calculations of the new year, their days commenced with dawn. (Contrarily, in general, among the people who depended on the new moon for their new month and new year, like the Arabs and the Jews, the reckoning of the days began with the sunset.)

The next period larger than the day, in Egyptian reckoning, was a week of 10 days (decade). Three such weeks—30 days—constituted a month. Even though this month had a lunar origin, in its new setting it was in no manner related to the moon.

Four months—120 days—composed a season. And the flood, sowing, and harvesting seasons, along with epagomenal days—five in common years and six in leap years—composed a year. This general idea of the common year and leap year was adapted by

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[7] F. A. Wallis Budge, *The Decree of Canopus*, pp. 28, 29, 120, 121. Kegan Paul, Trench, Trübner and Company, London, 1904.

Julius Caesar to the Roman reckoning.[8] The republican government of France adopted this calendar *in toto* in 1793.[9]

Unlike other ancient peoples, the Egyptians apparently paid no heed to the solstices and equinoxes until late in their history. In their pyramids, however, we discover an application of their knowledge of solar phenomena. The pyramids were colossal gnomons which made practical and possible the exact measurement of the shadows. The Egyptian temples were oriented to the rising position of the equinoctial sun—due east. The pyramids were built with amazing exactness; their four faces were squared precisely to front the four cardinal directions. They were so built that

> . . . between the autumn and spring equinoxes, the rays of the rising and setting sun illuminated the southern face of the pyramid; whereas during the rest of the year—that is, during the six months between the spring and autumn equinoxes—the rays of the rising and the setting sun illuminated the northern face. Again, all the year round the sun's rays passed from the eastern to the western face at solar noon. And lastly, during the seven months and a half of each year—namely, for three months and three quarters before and after midsummer—the noon rays of the sun fell on all four faces of the pyramid.[10]

That the pyramid builders were erudite mathematicians, keen astronomers, and versatile engineers is amply evidenced by the most exacting orientation of the four sides of the pyramid.

The pyramid builders were not only time-wise and calendar-wise but measurement-wise. In the pyramid of Cheops, better known as the Great Pyramid, were preserved the standards of length, area, capacity, weight, density, heat, time, and money. Apparently the standard of length was utilized to measure the shadow of the pyramid as well. With the aid of its shadows, the length of the solar year was exactly determined, which later led to the discovery of precession. The day on which the shadow from the rising sun coincided with the axis line joining due east with due west, the Egyptians knew it was an equinox. By counting the number of days between two similar equinoxes, the year was determined. Thus the Great Pyramid was at once a tomb, a temple, and an observatory—a symbol of the synthesis of Egyptian spirit, theology, and science.

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[8] See p. 67.

[9] See pp. 75, 76.

[10] R. A. Proctor, *The Great Pyramid*, p. 18. Chatto and Windus, London, 1883.

Another salient example of the solar calendar is found among the ancient Aztecs, on the other side of the world. The isolated Aztecs reckoned a solar year as consisting of 18 months, each of 20 days, with five days added at the end to make the year 365 days. The Aztecs, however, intercalated a day every fourth year, making a leap year of 366 days, and arrived at a singularly straight solar calendar.

THE HEBREW CALENDAR: A LUNI-SOLAR CALENDAR

All luni-solar calendars follow a general pattern of intercalating a full synodic month every two or three years in their normal calendar year of 12 lunations. The Jewish Calendar, because of its dominant religious characteristics and its synthesis of the calendrical lore of diverse origins, contains many complexities which make it an ideal subject for calendar study.

Even though the Jewish Calendar was impinged on by Egyptian influence, it managed to retain its original Babylonian characteristics. It was ordained at the Exodus that the new year would begin with the spring, and that the Passover would be held on the fourteenth of the first month Nisan (flight) [11] of the ecclesiastical year. The Christian churches later adopted this principle for the observance of Easter. In civil life, however, Jews came to observe the time for sowing, which was close to the autumnal equinox in Palestine, as ushering in the new year. The first day of the year began with the month Tishri and was reckoned by the new moon.

According to some Talmudic authorities, the world was created at the vernal equinox. According to still others, it was created at the autumnal equinox (September 21) [12] in the year corresponding to the year 3761 B.C. This later version is now accepted by all orthodox Jews. Four days after the creation of the earth, the sun and moon came into being in a like manner.[13] The

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[11] Exodus 12:8.

[12] M. Simon, *The Babylonian Talmud: Rosh Hashanah* (Trans.), p. 39. Soncino Press, London, 1938.

[13] Genesis 1:16, 19.

TABLE VI. AN ANALYSIS OF THE HEBREW CALENDAR

(300th Cycle = 6,940 Days)

Number of Cyclic Year		*Year A.M.*	*New Year Begins on*	*Days in Year*	MONTHS AND THE CORRESPONDING NUMBER OF DAYS												
					Tishri, 30	*Hesvan, 29*	*Kislev, 30*	*Tebet, 29*	*Shebat, 30*	*Adar, 29*	*Ve-Adar (intercalary)*	*Nisan, 30*	*Iyar, 29*	*Sivan, 30*	*Tammuz, 29*	*Ab, 30*	*Elul, 29*
1		5682	Oct. 3, 1921	355	Always 30 days	30+	30	Always 29 days	Always 30 days	29	–	Always 30 days	Always 29 days	Always 30 days	Always 29 days	Always 30 days	Always 29 days
2		5683	Sept. 23, 1922	353		29	29–			29	–						
3	E	5684	Sept. 11, 1923	384		29	30			30+	29						
4		5685	Sept. 29, 1924	355		30+	30			29	–						
5		5686	Sept. 19, 1925	355		30+	30			29	–						
6	E	5687	Sept. 9, 1926	383		29	29–			30+	29						
7		5688	Sept. 27, 1927	354		29	30			29	–						
8	E	5689	Sept. 15, 1928	385		30+	30			30+	29						
9		5690	Oct. 5, 1929	353		29	29–			29	–						
10		5691	Sept. 23, 1930	354		29	30			29	–						
11	E	5692	Sept. 12, 1931	385		30+	30			30+	29						
12		5693	Oct. 1, 1932	355		30+	30			29	–						
13		5694	Sept. 21, 1933	354		29	30			29	–						
14	E	5695	Sept. 10, 1934	383		29	29–			30+	29						
15		5696	Sept. 28, 1935	355		30+	30			29	–						
16		5697	Sept. 17, 1936	354		29	30			29	–						
17	E	5698	Sept. 6, 1937	385		30+	30			30+	29						
18		5699	Sept. 26, 1938	353		29	29–			29	–						
19	E	5700	Sept. 14, 1939	385		30+	30			30+	29						

300th Cycle Ends and 301st Cycle Begins

1		5701	Oct. 3, 1940	354		29	30			29	–						
2		5702	Sept. 22, 1941	355		30+	30			29	–						
3	E	5703	Sept. 12, 1942	383		29	29–			30+	29						
4		5704	Sept. 30, 1943	354		29	30			29	–						
5		5705	Sept. 18, 1944	355		30+	30			29	–						
6	E	5706	Sept. 8, 1945	383		29	29–			30+	29						

Data compiled from: (1) Rev. A. H. Nieto, *Jewish Almanac*. New York, 1902. (2) Rabbi S. W. Freund, *Corresponding Date Calendar*. New York, 1925.

E = Embolismic years.

+ A day added to the normal month.

– A day subtracted from normal month.

Jews have used this chronology of *Anno Mundi* (in the year of creation, or A.M.) for centuries, so that to obtain the Hebraic year we must add 3,761 years to the *Anno Domini* (in the year of our Lord, or A.D.) years.

As in other cultures, the secrets of the calendar were the exclusive domain of the priests. Designating the beginning of the approaching month and the feast and fast days, indicating whether the month would last 29 or 30 days, specifying whether the year would be common or embolismic, were some of the many tasks of the priests. Before the Christian Era, official declarations relating to religious and ceremonial days were made by the Sanhedrin—the Great Council of Jerusalem. These ceremonials have been incorporated in the calendar, which is now so complexly constituted that it is beyond the ken of unschooled laymen.

Patriarch Hillel II is presumed to have introduced a fixed calendar based upon a cycle of nineteen solar years, during which seven lunations are intercalated. To harmonize the seasons with the lunar months, the Jewish Calendar follows a cycle of 19 solar years. Years are therefore arranged in groups of 19 so that the first 19 years constitute the first cycle, the years 20 to 38 constitute the second cycle, and so on. The period beginning with the year A.M. 5682 and ending with the year A.M. 5700 is therefore called the three-hundredth cycle.

An analysis of the three-hundredth cycle of the Hebrew Calendar is given in Table VI. The first column shows the number of the cyclic year. The second and the third columns show that the new year (Tishri 1 of the year A.M. 5682) began on October 3, 1921. Tishri 1 can occur anywhere from September 6 to October 5, inclusive. From the fourth column we gather that the year A.M. 5682 had 355 days. The next thirteen columns give the data for the 13 months—twelve regular and the thirteenth intercalary month. The intercalary month *Ve-Adar* (second Adar) is sandwiched conspicuously in the table between two flanks of six months each. If we consider only the 12 *regular* months (excluding the intercalary *Ve-Adar*), we find the following general rule for the allocation of the number of days for each individual month:

Month	*Days*	*Month*	*Days*
Tishri	30	Nisan	30
*Hesvan	29	Iyar	29
*Kislev	30	Sivan	30
Tebet	29	Tammuz	29
Shebet	30	Ab	30
*Adar	29	Elul	29

The common year has six months of 30 days and six months of 29 days. This is the general pattern of distribution of months and days and hence the common year consists of 354 days. The intercalary month along with the three months indicated above with an asterisk are the exceptions. Thus the second month Hesvan, the third month Kislev, and the sixth month Adar complicate the calendar, as is indicated in Table VI by the plus and minus signs under these three columns. In a cycle of 19 years, a number of Hesvans have 30 instead of the usual 29 days, some Kislevs have 29 instead of the normal 30 days, and the Adars of the embolismic years have 30 days instead of the otherwise regular 29 days. The rest of the nine months always conform to the rule of distribution indicated above. The Ve-Adar always consists of 29 days.

Just as the Gregorian Calendar has two kinds of years, namely, the common and the leap years, the Jewish Calendar has common and embolismic years. In the Gregorian leap year a day is added, while in the embolismic year 30 days are intercalated after the usual month of Adar, one day being attached to Adar as a thirtieth day, and the remaining 29 days comprising the month of Ve-Adar. Thus the common year consists of 12 lunations and the embolismic year of 13 lunations. The common year, in turn, is of three different types; namely, 353, 354, and 355 days (see Column 4, Table VI). Similarly, the embolismic years comprise 383, 384, and 385 days. This annual variation in days is caused by the Mosaic and Rabbinic laws that prohibit the solemn first of Tishri, or New Year (Rosh Hashanah), Passover, the Day of Atonement (Yom Kippur), Feast of Lots (Purim), and Pentecost (Shebuot) from falling on certain weekdays.[14]

The Jewish Calendar accepted the value of a lunation as determined by Cidenas in 383 B.C. as 29.530594 days. Also accepted was the Babylonian value of the tropical year, which consisted of 365.2468 days, or 12.36842 lunations, which value is still continued in the Jewish Calendar. The 19-year cycle and the seven intercalations were also adopted from the Babylonians.[15] Thus the Jewish cycle in actual computations is considered to be 6939.6965665 days ($6939^d\ 16^h\ 43^m\ 3^s.3$). This value exceeds the actual value of 19 solar years by $2^h\ 16^m\ 31^s.2$.

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[14] Joseph Caro, *Shulhan Aruk* (Hebrew), Part I, par. 428.

How does one determine which year is embolismic and which is common? By means of this formula: Those Hebrew (A.M.) years which, when divided by 19, leave a remainder of 1, 2, 4, 5, 7, 9, 10, 12, 13, 15, 16, and 18 are common years of 12 lunar months, while those which leave a remainder of 3, 6, 8, 11, 14, 17, and 0 are embolismic years of 13 lunations. Table VI shows that the intercalary month of Ve-Adar occurs in the years 5684, 5687, 5689, 5692, 5695, 5698, and 5700. These seven years correspond to the third, sixth, eighth, eleventh, fourteenth, seventeenth, and nineteenth years, which constitute the sequence of embolismic years in any given Hebraic nineteen-year cycle.

The lack of *exactness* of the occurrence of the seasons in the Jewish Calendar can be gauged by the maximum and minimum variations as resulting from 30-day intercalations. Figure 3 is based on the occurrence of Tishri 1 (New Year) during the nineteen years of the three-hundredth cycle. Here the Jewish New Year, in relation to the autumnal equinox, advances or regresses almost every year. It happens that in the three-hundredth cycle only twice, in the A.M. years 5683 and 5691, did the Hebrew New Year fall on September 23. Six times it occurred within four days, before or after, the autumnal equinox; nine times, within a week; and thirteen times, within the limit of ten days. The extreme variations were seventeen and twelve days before or after the autumnal equinox, respectively. However, the maximum limit of variation being seventeen days, the autumnal deviation in a solar year amounts to 4.65 per cent, so that the maximum seasonal error caused by this luni-solar calendar is less than 5 per cent.

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[15] J. K. Fotheringham, *Nautical Almanac for 1935*, pp. 756–758. H. M. Stationery Office, London, 1934.

Thus we see that the effort to reconcile the lunar month and the solar year and the compulsion to accommodate the days of the week to religious dictates have resulted in an extremely complicated calendar. Even though a fairly accurate measurer of time,

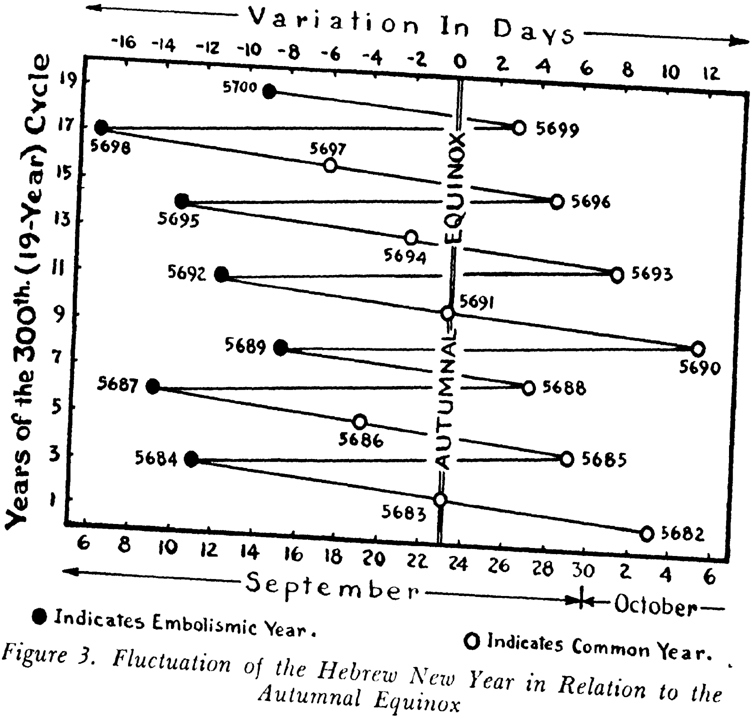

Figure 3. Fluctuation of the Hebrew New Year in Relation to the Autumnal Equinox

the Hebrew Calendar incorporates practically all the characteristics that negate it as an adequate modern instrument embodying simplicity, practicality, and efficiency.

OTHER ADAPTATIONS

THE HERITAGE OF OUR CALENDAR

Our current Gregorian Calendar springs from diverse origins. In it are blended numerous social and cultural heritages. For example, in all probability, the concept of the week and the names of the days come from Babylonia. Even our holidays are inherited from ancient cultures. Easter, for instance, owes its origin to the Jewish *Pasch* (Passover). The word Easter, derived from the name of the Teutonic goddess of spring, *Eastre*, resembles strikingly the Babylonian Ishtar. This resemblance turns to a kinship when we realize that the Easter festival parallels the Babylonian spring festival which initiated the Babylonian New Year. Again, the festival of Christmas was borrowed from India, Persia, Syria, and Egypt, where the winter solstice was regarded as the nativity of the sun born of a heavenly virgin.[16] And so the heavenly virgin was transformed into the Virgin Mary, and the nativity of the sun was celebrated as the Nativity of the Son. Even the duration of the solar year and the general pattern of our calendar were inherited from Egypt. The names of the months and the allocation of the days in the months are the bequest of the Romans.

THE ROMAN CALENDAR

Historians indicate that the wild tribes of northern Europe observed a year of ten months. The year began with the sign of spring and continued for nearly ten months. It terminated when the ground froze and winter put forth its full fury. For about a period of sixty days the severe cold probably drove the early northern man to hibernation, and he took the calendar along with him. Thus the period corresponding to January and February was calendrically in abeyance. The prehistoric Romans are presumed to have adopted this arrangement from their northern neighbors. According to tradition, King Romulus, founder of Rome, is supposed to have recognized officially the use of this 10-month northern calendar in 738 B.C. (circa). However, the 10-month idea appears valid as is shown by the etymology of the original ten months of the Roman Calendar ending in December.

The earliest known Roman calendar (about the eighth century B.C.) comprised ten months which had the following names and the corresponding significance:

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[16] J. G. Fraser, "Adonis Attis Osiris." *The Golden Bough*, Part IV, Vol. I, pp. 301 ff. The Macmillan Company, New York, 1935.

Martius was dedicated to the god of war, Mars, and apparently implied that the season for the resumption of warfare had commenced.

Aprilis (from Latin *aperire* meaning "to open") indicated the season of budding leaves and opening petals.

Maius after Maia, the goddess of growth, ushered in the month favoring the growth of plants.

Junius, after Juvenis, meant youth and implied that the period of maturity of plant life had arrived.

The other six months, Quintilis, Sextilis, Septembris, Octobris, Novembris, and Decembris, respectively, represented the fifth, sixth, seventh, eighth, ninth, and tenth months. The Roman day began at midnight, a custom indicating the earlier lunar origin. The Roman year later, during the reign of Julius Caesar, began near the winter solstice, showing a solar influence.

From Table VII a comparison of the Roman calendars can be drawn. This table shows the evolution through five basic stages. The Roman 10-month year consisted of 304 days, with one month of 29 days, four months of 30 days each, and five months of 31 days each. This Roman year was approximately 61 days short of the solar year, and 50 days short of the lunar year.

King Numa Pompilius, who succeeded Romulus, found that the 10-month arrangement did not meet the needs of life in the moderate climate of his domain. Thereupon, following the Greek practice, he introduced a lunar year and added the month of Januarius, named after Janus, the guard of heaven and protector of gateways and, therefore, the beginner of things, and also introduced Februarius, named after Februalia, the time when sacrifices to appease the gods and to atone for the sins of the concluding year were performed. Some authorities hold that Numa really introduced Januarius before Martius, and Februarius after Decembris of the 10-month Roman Calendar to symbolize the birth and death of the year. The usage of the words *Januarius* and *Februarius,* philologically, favors this view.

And so the Roman New Year began in Rome on the day that corresponds to our March 25, the time when the vernal equinox was then observed.

Since among the Romans the even numbers symbolized death,

TABLE VII. A COMPARISON OF ROMAN CALENDARS

Calendar Named After:	*Days in the Year*	SEQUENCE OF MONTHS IN THE YEAR AND CORRESPONDING NUMBER OF DAYS											
		1	2	3	4	5	6	7	8	9	10	11	12
Romulus *ca.* 738 B.C.	304	Martius 31	Aprilis 30	Maius 31	Junius 30	Quintilis 31	Sextilis 30	Septembris 31	Octobris 30	Novembris 31	Decembris 29		
Numa *ca.* 713 B.C.	355	Martius 31	Aprilis 29	Maius 31	Junius 29	Quintilis 31	Sextilis 29	Septembris 29	Octobris 31	Novembris 29	Decembris 29	Januarius 29	Februarius 28
Decemvirs *ca.* 451 B.C.	355	Januarius 29	Februarius 28	Martius 31	Aprilis 29	Maius 31	Junius 29	Quintilis 31	Sextilis 29	Septembris 29	Octobris 31	Novembris 29	Decembris 29
Julius *ca* 47 B.C.	365¼	Januarius 31	Februarius 29–30	Martius 31	Aprilis 30	Maius 31	Junius 30	Julius 31	Sextilis 30	Septembris 31	Octobris 30	Novembris 31	Decembris 30
Augustus *ca.* 8 B.C.	365¼	Januarius 31	Februarius 28–29	Martius 31	Aprilis 30	Maius 31	Junius 30	Julius 31	Augustus 31	Septembris 30	Octobris 31	Novembris 30	Decembris 31

Slanted arrows indicate change in relative positions, and direct arrows indicate change in the names of months.

their use was shunned; the odd numbers were considered propitious because they represented life. In the calendar of Numa we find seven months of 29 days, four months of 31 days, and a twelfth month, Februarius, of an even 28 days. Thus a year of 355 days approximated the lunar year and, in consonance with the then current superstition, ended the year with an unlucky number, thereby obviously symbolizing the death of the concluding year. It was to avoid the unlucky number of a lunar year of 354 days that the year was made to reckon 355 days.

About 451 B.C. the Decemvirs (a council of ten magistrates), under their leader Appius Claudius, reshuffled the months and gave the calendar the current order of months; that is, they shifted the beginning of the year from Martius to Januarius and ended the year with Decembris instead of Februarius. They did not change the duration of the months, but left them intact as Numa had devised them.

Numa is also reputed to have founded the College of Pontiffs (consisting of four pontiffs and the presiding Pontifex Maximus) as an outgrowth of Decemvirs. The College did not follow any specific divine persuasions but assumed temporal authority that was backed with the prestige of the state religion. The College immediately took the calendar under its authority. The Pontifex Maximus officially declared the date, ceremonies, and festivals of the year. For nearly four and one-half centuries knowledge of the calendar was strictly confined to the pontifices. According to Plutarch, Numa synchronized the lunar months with the solar year by introducing an intercalary month of 22 or 23 days, which was called *Mercedonius.* It was inserted every second year to align the seasons and the months with the solar year.

Weights and measures, as well as the calendar, eventually became the monopoly of the pontifices. These officials wielded great influence and authority and hence manipulated weights, measures, and calendar to suit their purposes. Since they determined and declared the exact date of the festivals, and were the exclusive keepers of the calendar, they did not hesitate to misuse it for political and economic purposes. They were able to manipulate the months to their advantage in the collection of rents, taxes, and interest.

JULIAN (OLD STYLE) CALENDAR

The corruption and fraud to which the pontiffs subjected the calendar resulted in its deterioration, so that by the time of Julius Caesar it was entirely at variance with the seasons. In fact, it was so badly scrambled, and the public so disgruntled with it, that it afforded Julius Caesar a unique opportunity to make drastic changes and necessary reforms when he assumed the office of Pontifex Maximus. After his conquest of Egypt, Caesar commissioned the famous Alexandrian astronomer, Sosigenes, to formulate a fixed, stable, and reliable calendar. On the advice of Sosigenes, Julius Caesar interpolated a year of 445 days to restore the calendar to its former position in relation to the seasons. This extraordinary year of 445 days came to be known as the Year of Confusion. To avert any similar calendrical confusion in the future, he set Sosigenes to work.

Sosigenes made Caesar aware of the discrepancy between the solar and lunar years and the futility of reconciling them. He therefore advised the dictator to replace the lunar year by a solar year of 365 days and 6 hours—the value that was then considered exact and had been introduced in Egypt officially by the Decree of Canopus as early as 238 B.C., when the leap year was first introduced. Convinced by the overpowering logic of Sosigenes, Julius Caesar, in 45 B.C., broke away from the traditional Roman lunar calendar and adopted the mean value of the year as 365¼ days. This constitutes the basis of the present arrangement of our calendar. Thus was adopted the Egyptian solar year with a cycle of 4 years, three common years of 365 days and the fourth leap year of 366 days. Caesar decreed, further, that during leap years the odd months would consist of 31 days, and the even months of 30 days. The same condition held true for common years with the exception of February, which would have only 29 days. Consequently the months Januarius, Martius, Maius, Quintilis, Septembris, and Novembris each consisted of 31 days; the months Aprilis, Junius, Sextilis, Octobris, and Decembris each consisted of 30 days; and Februarius had 29 in common years and 30 in leap years. This arrangement was named after him, the Julian Calendar, and wrought the following changes: (1) It eliminated all compromises by abolishing the lunar year and dropped the moon reckoning from the calendar, thereby breaking its relationship to the months. (2) It adopted the solar year of 365¼ days, thereby standardizing every group of four years into three of 365 days, and the fourth year of 366 days. (3) It restored the vernal equinox to its original place, which corresponds to our March 25.[17] (4) It commenced the year with January 1. It is presumed that Julius Caesar shifted the beginning of the year to January 1 because he wanted to begin the year with the shortest day—the winter solstice—which then fell on December 25. However, in deference to the custom of reckoning by the lunar month, he is supposed to have delayed the change seven days to conform to the rising of the new moon which fell on January 1. If he had not had to compromise with the entrenched social and religious customs of his day, which were the vestiges of an ancient lunar worship, he might have been able to institute a calendar accurately synchronized to the beginning of the winter solstice. If he had been able to ignore the moon completely, what a contribution he would have made to calendar reform! (5) It renamed Quintilis, Julius, after Julius Caesar to commemorate the reforms he had introduced in the calendar.

The Julian Calendar eliminated the variability and unpredictability of the Roman Calendar. Adoption of the Egyptian solar year was a step of first magnitude in the rationalization of the calendar. However, perpetuation of the old irregular months was a considerable handicap.

AUGUSTAN CHANGES OF THE CALENDAR

After Caesar's death the leap-year rule was again misinterpreted by the pontifices. For thirty-six years they intercalated the leap-year day every third year instead of every fourth. Augustus Caesar compensated for this error by omitting three intercalations between 8 B.C. and A.D. 8. Thus A.D. 8 was the first of the new series of leap years, and the beginning of our current practice of observing leap year in only such years as are multiples of the number four. Later, in the reign of Augustus, the month Sextilis was renamed Augustus to do the emperor honor. An extra day was added to the month of Augustus, making a total of thirty-one, in order to eliminate the omen of ill luck associated with an even number; to compensate for this, a day was dropped from Februarius. That is how we came to have a February of 28 days in normal years and one of 29 in leap years. To balance the rest of the calendar, Septembris and Novembris were reduced from 31 to 30 days; Octobris and Decembris were increased from 30 to 31 days; while the months Januarius, Martius, Aprilis, Maius, Junius, and Julius were left intact, as in the Julian Calendar. This explains how we came to have the sequence and length of months we have in our calendar today.

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[17] G. Sarton, *Introduction to the History of Science*, Vol. I, p. 216. Carnegie Institution of Washington, 1927.

It should be noted here, however, that this view of the changes made by Augustus Caesar is vigorously contested by some scholars. Dr. Roscoe Lamont cites Censorinus and Macrobius to prove that it was Julius Caesar, and not Augustus, who gave the months the sequence of days we now possess.[18] Lamont agrees that prior to the time of Julius Caesar the year consisted of 355 days and that Julius added ten days to the calendar, but insists that he distributed them over the twelve months, as shown below in the second row of figures. The third row of figures indicates the structure of our present calendar.

Before Julius Caesar

Lunar Year of 355 Days

Jan.	*Feb.*	*Mar.*	*Apr.*	*Mai.*	*Jun.*	*Quin.*	*Sex.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*
29	28	31	29	31	29	31	29	29	31	29	29

Julius Caesar added 10 days

Jan.	*Feb.*	*Mar.*	*Apr.*	*Mai.*	*Jun.*	*Quin.*	*Sex.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*
2	0	0	1	0	1	0	2	1	0	1	2

After Julius Caesar

Solar Year of 365 Days

Jan.	*Feb.*	*Mar.*	*Apr.*	*Mai.*	*Jun.*	*Jul.*	*Sex.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*
31	28	31	30	31	30	31	31	30	31	30	31

Such, then, are the antecedents and organization of the calendar we use today.

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[18] R. Lamont, "The Roman Calendar and Its Reformation by Julius Caesar." *Popular Astronomy*, Vol. XXVII, No. 9, pp. 583–595, November, 1919.

THE CHRISTIAN CALENDAR

In A.D. 325, at the General Council of Nicea, the Christian Calendar was formalized by the decree of Emperor Constantine. In that particular year the vernal equinox had occurred on March 21. At this Council the day for Easter was specified as the "first Sunday upon or after the first full moon following the twenty-first day of March," [19] (vernal equinox) and was decreed to be celebrated throughout Christendom.

The practice of figuring Christian dates from the birth of Christ is attributed to Dionysius Exiguus (the little), a Scythian monk and Abbot of Rome, in A.D. 532. He is credited with the official establishment of the paschal cycle (Easter cycle of 532 years). He is also supposed to have designated A.D. 532 as the first period of a new Easter cycle, and in that manner placed the birth of Christ in A.D. 1. However, the birth date is contested by modern scholars in favor of the year 4 B.C.

Dionysius acknowledged the then-current tradition of recognizing March as the month of *Annunciation,* and specified March 25 as the date of Christ's conception. He also fixed March 25 as the beginning of the Christian year. This practice was followed until 1582, when Pope Gregory XIII reverted to January 1—a change Julius Caesar had initiated more than sixteen centuries earlier. The reason ascribed to Pope Gregory for this shift is that January 1 represented the Feast of the Circumcision,[20] which occurred on the eighth day after Christ's birth.

Since all the movable Christian feasts were hinged on Easter, and since Easter was dependent on the full moon and the vernal equinox, it became imperative to arrange the calendar so that spring always began *on* March 21. Because the civil year was not in agreement with the solar year, a deviation of the vernal equinox from this fixed date was inevitable.

The mean tropical year is approximately 365.2422 days in length. The Julian year of exactly 365.25 days was, therefore, longer than the tropical year by 0.0078 of a day. This difference, if permitted to cumulate, would add up to about 3 days in 400

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[19] W. Hales, *Chronology and Geography,* Vol. I, p. 51. C. J. G. & F. Rivington, London, 1830.

[20] Luke 2:21.

Julian years, or, more accurately, one day in 128 years, so that 128 years after the Council of Nicea, in A.D. 453, the vernal equinox occurred on March 20. In another 128 years, that is, in A.D. 581, the vernal equinox had receded two days and occurred on March 19. The data pertaining to the drift of the vernal equinox in terms of the Julian calendar are given in Table VIII.

TABLE VIII

Drift of Vernal Equinox and the Corresponding Julian Years

March 21	A.D. 325	March 14	A.D. 1221
March 20	A.D. 453	March 13	A.D. 1349
March 19	A.D. 581	March 12	A.D. 1477
March 18	A.D. 709	March 11	A.D. 1605
March 17	A.D. 837	March 10	A.D. 1733
March 16	A.D. 965	March 9	A.D 1861
March 15	A.D. 1093	March 8	A.D. 1989

This recession, if left unchecked, in time would have caused the spring to occur in the month of December.

THE GREGORIAN (NEW STYLE) CALENDAR

Recognizing this recessive drift, Roger Bacon in the thirteenth century wrote a treatise on the error of the Julian Calendar and sent it to Pope Clement IV, but without results. As the years rolled on, the error kept mounting, so that when the nineteenth General Council met at Trent in 1545, the vernal equinox occurred on March 11, a recession of exactly ten days from the time of the Council of Nicea.

The Council of Trent in 1545 authorized the Pope to rectify this situation. A great many discussions and deliberations were held until 1582. In that year Pope Gregory XIII, on the advice of the astronomer Luigi Lillio Ghiraldi, also known as Aloysius Lilius, and the mathematician Christopher Clavius, decided to reform the calendar and, once again, bring the vernal equinox forward to the date observed by the august Nicean Council, that is, to March 21. In accordance with this decision, Gregory, by his Papal Bull *Inter Gravissimas,* of February 24, 1582, decreed that the day following Thursday, October 4, 1582, would be called Friday, October 15, 1582. To prevent a recurrence of this situation, he also decreed the dropping off of three leap-year days every

400 calendar years. This rule, as originally formulated by Ghiraldi and later interpreted and adapted by Clavius, was that the three century years in every four centuries that are not integrally divisible by 400 will be considered common years and *not* leap years, as had been dictated by the Julian rule. Accordingly, the year 1600 remained a leap year in both the Julian and the Gregorian calendars. The days of the week of the two calendars remained identical and ran concurrently. The years 1700, 1800, and 1900 of the Julian Calendar remained leap years. On the other hand, in the Gregorian Calendar, the month of February for the years 1700, 1800, and 1900 had only 28 days. The year 2000 is leap year in both. Therefore, to convert the date from the Gregorian to the Julian Calendar, the following rule must be observed:

Subtract ten days from all dates from October 15, 1582, to February 28, 1700, inclusive; subtract eleven days from dates between March 1, 1700, and February 28, 1800, inclusive; subtract twelve days from the dates between March 1, 1800, and February 28, 1900, inclusive; and subtract thirteen days from dates between March 1, 1900, and February 28, 2100, inclusive. (For the method of determining the day of the week for both the Julian and the Gregorian calendars, see Appendix B, pp. 131-132.)

This arrangement of dropping three days in four centuries makes the Gregorian Calendar year one of 365.2425 days (365^d 5^h 49^m 12^s). Because this desirable change was brought about by Pope Gregory, the present calendar is called the *Gregorian Calendar,* although it is sometimes also referred to as the *New Style Calendar.*

The Gregorian year is still approximately 0.0003 of a day (about 26 seconds) longer than the average tropical year. This difference of 26 seconds a year would amount to a day in 3,323 years. To correct this error, the astronomer Herschel suggested dropping a leap year every 4,000 years.[21] In 1864 Professor Medler of Dorpat University proposed to readjust the Julian Calendar, then used in Russia, by dropping a leap year every 128 years instead of the three centurial leap years in every 400 years as in the Gregorian Calendar. This practice would provide the most accurate method of patterning our calendar and would eliminate the necessity of correction as suggested by Herschel. Long before, in the eleventh century, Omar Khayyam, known more for his contributions as poet than as astronomer and mathematician, advocated the intercalation of 8 days in every 33 years. His proposal would have averaged 365.242424 days in a year, and thus was slightly more accurate than the Gregorian Calendar.

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[21] John Herschel, *Treatise on Astronomy,* p. 41. Longman, Brown, Green and Longman, London, 1843.

To adopt the Gregorian Calendar, the British Parliament passed the Calendar New Style Act in 1750; and since the vernal equinox had by that time receded nearly eleven days, the Act provided that eleven days be dropped from the calendar. Accordingly, Wednesday, September 2, 1752 (Julian Calendar), was followed by September 14, 1752 (Gregorian Calendar), which was designated as Thursday, in England and her colonies the world over.[22] At that time also, England, which had until then observed March 25 as New Year's Day, began the year on January 1.[23]

COMPARISON OF DIFFERENT TIME UNITS

If we compare the common elements of the various time units, we can see their relative values more clearly. For our purposes, the day and the week will serve as basic elements. Table IX furnishes data for such a comparison.

TABLE IX

LUNATIONS AND YEARS IN TERMS OF DAYS AND WEEKS

Time Units	*Duration in Days*	*Equivalent Weeks*
Synodic month (one lunation)	29.530588 ($29^d\ 12^h\ 44^m\ 2^s.8$)	4.2186...
Lunar year (12 lunations)	354.367056 ($354^d\ 8^h\ 48^m\ 34^s$)	50.6238...
Solar (tropical) year	365.2422 ($365^d\ 5^h\ 48^m\ 46^s$)	52.1774...
Julian year	365.250 ($365^d\ 6^h$)	52.1785...
Gregorian year	365.2425 ($365^d\ 5^h\ 49^m\ 12^s$)	52.1775...

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[22] For a discussion of how the adoption was made in the American Colonies, see the 1752 and 1753 *Poor Richard's Almanack* by Benjamin Franklin.

[23] The Bank of England to this day follows the practice of using March 25 as the beginning of the fiscal year, and so does the Church of England.

Neither the lunar or the solar year nor the synodic month is a whole number; they run over into fractions, whether they are calculated by days or by weeks. This holds true for the Julian, as well as for the Gregorian, year. Therefore, neither the day nor the week can possibly be adequately fitted into the solar year without some measure of intercalation. The relative difference and cumulative error of different time units are indicated in Table X.

TABLE X

DIFFERENCES IN THE DIVERSE YEAR UNITS

Year Units Compared		*Difference in Year Units in Days*	*Cumulative Error*	
			One Day	*In 400 Solar Years*
Solar	>Lunar	+10.8751 (10^{d} 21^{h} 0^{m} 12^{s})	Behind in 0.092 sol. yrs.*	4350 da. behind
Solar	<Julian	−0.0078 (. . . . . . 11^{m} 14^{s})	Ahead in 128 sol. yrs.	3.12 da. ahead
Gregorian	<Julian	−0.0075 (. . . . . . 10^{m} 48^{s})	Ahead in 133 sol. yrs.	3.00 da. ahead
Solar	<Gregorian	−0.0003 (. . . . . 26^{s})	Ahead in 3323 sol. yrs.	0.12 da. ahead

* This amounts to a gain of one solar year in every 33.5851 solar years. Putting it differently, 33 solar years are equal to approximately 34 lunar years.

Table X shows that the solar year is longer than the lunar year, but shorter than either the Julian or the Gregorian year. The Gregorian year is also shorter than the Julian year. The values of these differences of year units are given in column 2. The third and the fourth columns indicate the cumulative error between any two types of year in reference to the solar year. Thus, the third column shows that, mathematically, in about 0.092 of a solar year, the lunar reckoning falls a day behind; in 128 solar years the Julian Calendar is a day in excess of the solar reckoning; in 133 solar years the Julian Calendar is one day in advance of the Gregorian reckoning; and finally, in 3,323 solar years the Gregorian Calendar also will be a day ahead of solar reckoning.

The last column shows the cumulation of error between different year units in a period of 400 solar years. Thus the difference between lunar and solar years in this period amounts to 4,350 days; the Julian Calendar would be 3.12 days ahead of the solar reckoning. The difference between Gregorian and Julian years amounts to 3 days in 400 solar years, while the difference between 400 solar and 400 Gregorian years is 0.12 of a day (2^{h} 52^{m} 48^{s}). This explains why the Gregorian Calendar approximates the solar year and is fairly accurate in reckoning but will need a correction of a day in A.D. 4905.

The inadequacy of the Gregorian Calendar lies in its subdivisions, namely, the months and the weeks. Because the Gregorian Calendar has four standard months of 28, 29, 30, and 31 days' duration, and because the new year can start on any of the seven days of the week, there are twenty-eight different kinds of months (see page 17). Similarly, because of the common and the leap years, there are fourteen different kinds of years. This diversity of years is indicated in Table III. It was to eliminate the confusion caused by such diversity that the Republic of France initiated the Revolutionary Calendar.

MODERN EXPERIMENTS IN CALENDAR REFORM

Experimenting with social instrumentalities is always considered a radical practice, and is fraught with revolutionary potentialities. We have seen how Pope Gregory XIII made the last significant improvement in our calendar in 1582. Since then only two reconstructions of it have been attempted. Both were directed by revolutionary regimes, one in France and the other in Russia.

THE FRENCH REVOLUTIONARY CALENDAR

A year after the French Revolution and the establishment of Revolutionary authority, all popular publicists, individuals, and bodies subscribing to the Republican cause began dating their years as the "second year of the Republic." As the days passed and Republican enthusiasm grew, the Gregorian Calendar came to be regarded as increasingly unreasonable—a hang-over of the old regime. The Republic sought a practical, utilitarian, rational, and effective calendar. The Republic also desired to eliminate the grip and minimize the influence of the Catholic Church. To that end, the National Convention of Revolutionary France commissioned the President of the Committee on Public Instruction Charles Gilbert Romme, the astronomer Simon Laplace, the mathematicians Gaspard Monge and Joseph Louis Lagrange, and the poet Fabre d'Eglantine to design a new calendar. This eminent company of learned men recommended the Revolutionary

Calendar, very similar to the Egyptian Calendar, of twelve 30-day months with 5 and 6 intercalary days. Their recommendation was duly approved and adopted by the Convention, and was put into effect by the decree of November 24, 1793.[24] Later, the Revolutionary Convention enacted the Law of 18 Germinal anno III (April 7, 1795), which defined precisely the different units of measurement and resulted in the metric system,[25] a highly rational system and one of the most significant contributions in the history of mankind. The law establishing the calendar was given retroactive authority to have been effective as of the first year of the Republic, September 22, 1792, almost a year before its adoption. In this manner the first French Republic brought about a calendrical change.

As the Republic began near the autumnal equinox, the new year was made to commence at midnight of the Paris observatory time between the 21st and 22nd of September, 1792. The year was written in Roman numerals and began with year I commemorating the birth of the Republic. Each period of four years was called a *Franciade,* and the years of 366 days were called *Sextile.* The decimal method of calculation was applied to the calendar. The week of seven days was replaced by a 10-day week called a *Decade.* The sabbath was displaced by the tenth day, which was called a *Decadi.* Three decades comprised a month. The days of the Decade was called *Primidi, Duodi, Tridi, Quartidi, Quintidi, Sextidi, Septidi, Octidi, Nonidi,* and *Decadi.* Each day was divided into ten hours, each hour into one hundred minutes, and each minute into one hundred seconds, and the system of time from a second to the month became as follows:

100 seconds = 1 minute
100 minutes = 1 hour
10 hours = 1 day
10 days = 1 decade
3 decades = 1 month

[24] G. G. Andrews, "Making the Revolutionary Calendar." *The American Historical Review,* Vol. XXXVI, No. 3, p. 531, April, 1931. The Macmillan Company, New York.

[25] W. Hallock and H. T. Wade, *Outlines of the Evolution of Weights and Measures and the Metric System,* pp. 53 ff. The Macmillan Company, New York, 1906

Clocks with new dials were ordered to conform to the new decimal way of marking hours, minutes, and seconds. However, because the suddenness of the new arrangement baffled the people, the subdivisions of the day were put off for a time, and eventually given up in 1795. Again, we see how the logic of science fell a victim to the established habits of society.

The poet d'Eglantine furnished a vivid imagination, and the three scientists supplied the uncontested astronomical facts. From their joint efforts emerged the design of the months. They grouped the twelve months according to the seasons, as existing in general, in France, and descriptively named each month after some conspicuous characteristic peculiar to it. The seasons and months comprising them follow:

Seasons and Months (Revolutionary Calendar)		*Month Begins Approximately (Gregorian Calendar)*
	AUTUMN	
1. *Vendémiaire*	(vintage)	September 22
2. *Brumaire*	(fog)	October 22
3. *Frimaire*	(frost)	November 21
	WINTER	
4. *Nivôse*	(snow)	December 21
5. *Pluviôse*	(rain)	January 20
6. *Ventôse*	(wind)	February 19
	SPRING	
7. *Germinal*	(seed)	March 21
8. *Floréal*	(blossom)	April 20
9. *Prairial*	(pasture)	May 20
	SUMMER	
10. *Messidor*	(harvest)	June 19
11. *Thermidor*	(heat)	July 19
12. *Fructidor*	(fruit)	August 18

Thus the twelve 30-day months accounted for 360 days. The residual five days in the common years were called *sans-culottides*[26] and were named in honor of the following:

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[26] So named in memory of the *sans-culottes,* the ragged poor of Paris, who played a decisive role in the Revolution.

Les Vertus	(the virtues)	September 17
Le Génie	(the genius)	September 18
Le Travail	(the labor)	September 19
L'Opinion	(the opinion)	September 20
Les Récompenses	(the rewards)	September 21

The leap-year day was called *La Sans-Culottide* and was dedicated to sports.

With the fall of the Republic, the short-lived calendar was terminated after a life of thirteen years. Napoleon replaced the Directory with the Consulate on 18 Brumaire anno VIII (November 9, 1799). Despite his seeming preference for the Revolutionary Calendar, Napoleon used it as a bargaining wedge for a Concordat with the Pope. He obtained the Pope's formal recognition of his personal authority over France[27] and parts of conquered Europe and, as a price, abolished the Revolutionary Calendar and reintroduced the Gregorian Calendar, with its saints' days and church holidays, beginning with January 1, 1806. Furthermore, by that time the Gregorian Calendar had received wide acceptance throughout the world and had come to be recognized as an instrument of international usage. The Revolutionary Calendar, because of its parochial nomenclature, was geographically impractical even in France, where the seasons varied slightly from those described by the names of months.

SOVIET EXPERIMENTS WITH THE CALENDAR

In Czarist Russia the conflict and rivalry between the Roman Catholic Church and the Orthodox Greek Church made adoption of the Gregorian Calendar impossible. The Russian scientist Medler therefore adroitly suggested a compromise in 1864. He proposed that Russia introduce into its calendar (Julian) the practice of dropping a leap day every 128 years. This would give a more scientifically accurate calendar than the Gregorian, which dropped three leap days every four hundred years. However, Medler's proposal, despite the fact that it had logic and science on its side, was turned down, and Russia continued to use the Julian Calendar, even though in international affairs she followed the Gregorian. In 1918, after the Revolution, when Church and State were completely divorced, the Soviet government, on the recommendation of Lenin, adopted the Gregorian Calendar "for the purpose of being in harmony with all the civilized countries of the world." On January 26, 1918, Lenin as Chairman of the Council of People's Commissars signed a decree which cut thirteen days from the Julian Calendar and brought Russia in harmony with the rest of the world by the adoption of the Gregorian Calendar.

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[27] L. R. Gottschalk, *The Era of French Revolution*, p. 341. Houghton Mifflin Company, Boston, 1929.

Beginning October 1, 1929, the Union of Soviet Socialist Republics replaced the seven-day week with a five-day week. The decree of the People's Commissars stated that the year would consist of 12 months of 30 days, each month having six weeks. Each 5-day week was to have four working days, the fifth to be a *Free Day*. The extra five days of the normal year and six days of the leap year were declared Soviet holidays. A few special industries were to be operated on a 6-day week, with five days of labor and a day of rest.

One special feature of this Soviet Calendar was the *Nepreryvka,* or the uninterrupted week, made possible by staggering the Free Day. An industry thus could run every day of the week and, if necessary, without interruption around the clock and throughout the calendar year. Since most industries were working on a 5-day week basis, most workmen had every fifth day off. This implied that every day 20 per cent of the population of the U.S.S.R. were at rest, while 80 per cent were at work. Naturally this practice spread the Free Days throughout the week, and only a few annual occasions of national celebration constituted common holidays for all. This uninterrupted week and scattered Free Day arrangement was primarily motivated by the need of making the optimum use of machinery in order to achieve maximum production.

A main source of trouble in this calendar was the staggered Free Day. The diversity of the Free Day resulted in great inconveniences to families, since each working member might have a different day of rest. The Soviet government set up necessary machinery to rectify this situation and to enable the working members in a family to have the same day of rest. Another minor feature that contributed to the seeming impracticality of the new calendar was the shortness of the 5-day week and the psychological results ensuing therefrom.

The 5-day week and the staggered Free Day system were discarded in 1932 and replaced by a new plan which divided the year into 12 months, each month having 5 weeks of 6 days' duration. The twelve 30-day months were replaced by the months of the Gregorian Calendar. The days of the week, however, were counted as from first, second, on to sixth, and had no names. The Free Day fell on the sixth, twelfth, eighteenth, twenty-fourth, and thirtieth of every month. In the case of February, the week was either extended from the twenty-fourth of that month to March 6 or cut into two short weeks by having March 1 proclaimed a holiday. In the case of the months that had 31 days, the thirty-first day was a working day with extra pay in some industries, and in others a day off. In most schools and industries, before the war, the day was spent in instructive games or was entirely devoted to military exercises.

Elimination of the staggered system from the six-day week made it notable in contrast to the five-day week, inasmuch as it enabled family and friends to spend the Free Day together. Excepted from the rule were public utilities and hospitals, which in the Soviet Union, as in other countries, must be operated continuously. Other exceptions included the chemical and steel industries, in which four days of work and one day of rest were deemed so practical and desirable in relieving the excessive strain upon the worker that they retained the otherwise discarded five-day week.

Elimination of the seven-day week and the practice of using numbers to indicate the day removed the names of the weekdays from common usage in urban areas. In rural areas, however, old social habits persisted and the ancient names of the seven days remained intact. The total effect of the Soviet Union's calendar reforms, therefore, was that only the industrial population observed the six-day week, some special industries followed the five-day week, and farmers, officials in the Foreign Office, and men and women who had to deal with foreign countries used the seven-day week. Otherwise, the calendar, so far as the months and number of days in the month were concerned, was identical with the Gregorian.

Recognizing the danger "toward the security and peace of their country in a World War," the All-Union Central Council of Trade Unions, as a measure of preparedness and vigilance, appealed to the Soviet government to extend the working period. In compliance, the Presidium of Supreme Soviet of the U.S.S.R. decreed [28] the shift from a 60-week year based on a six-day week to the 52-week year based on a seven-day week. Since June 27, 1940, the Soviet Union has again followed the Gregorian Calendar and, as a result, the seven-day week has been the rule for all state, cooperative, and social enterprises. This means that the day of rest is again officially observed once in seven days instead of once in six days or once in five days, as was the case in the six-day and five-day week, respectively.

In such manner have the two revolutionary governments of France and Russia attempted experiments in the improvement of the calendar. An understanding of these efforts, and the earlier history of the calendar, will enable us to project and plan a more rational and practical instrument to meet the exigencies of a world that is now knit so intimately through rapid transportation and communication that it cannot afford diverse calendars.

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[28] For the text of edict, see *Moscow News*, p. 10, July 3, 1940.

CHAPTER IV

PROPOSALS AND TRENDS IN CALENDAR IMPROVEMENT

> *"The past brings us many gifts: indeed, all that we have today of culture, civilization, science or knowledge of some aspects of the truth, is a gift of the distant or recent past to us. It is right that we acknowledge our obligation to the past. But the past does not exhaust our duty or obligation. We owe a duty to the future also, and perhaps that obligation is even greater than the one we owe to the past. For the past is passed and done with, we cannot change it; the future is yet to come, and perhaps we may be able to shape it a little. . . ."* [1]—JAWAHARLAL NEHRU

BASIC CONCEPTS

THE CONCEPT of planning is at least as old as agriculture, when man devised the calendar to forecast the rhythm of the seasons the better to plan and regulate his plowing, seeding, and harvesting. Planning presumes a recognition of past experiences, and of consciously putting to use in a projected future the knowledge acquired from those experiences the better to serve the need of a community. Since the advent of agriculture, man, in anticipation of an approaching season, has applied the techniques of planning. Like other instrumentalities, the emphases on planning have varied with the times to conform to dominant needs, tools, and techniques.

With advancing technology and rapid transportation, with almost instantaneous communication, and with the increasing pressure of war, man has become more plan-conscious than ever before. Almost everywhere in the world, natural and human resources are being marshaled to conform to highly developed plans. Thus, war is especially utilizing the superlative techniques, tools, and talents known to the planning world, and is synchronizing them to obtain optimum results. In the face of such a highly developed instrumentality as a twentieth century war plan, is it not ironical that the instrument through which the plan is made operative should be based on a medieval and singularly erratic calendar?

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[1] J. Nehru, *Glimpses in World History,* pp. 951-952. John Day Company, New York, 1942.

We have seen that our system of time reckoning has evolved through day and night, moon and its ebbs, seasons and their changes. From a study of these natural phenomena we obtained our concepts of lunar, luni-solar, and solar calendars. Thus our calendar contains the record of practices begun in antiquity and traced through the Chinese and Hindu, Babylonian and Egyptian, Hebrew and Greek civilizations and through the ages to the Romans of Numa and the Decemvirs, of Julius and Augustus. Finally, it assumed its present Gregorian form. In this patchwork are encrusted the whimsies of kings and dictators, the superstitions and myths of past ages and the dogmas of priests, the folklore of the people, and the astronomical knowledge of diverse cultures. Thus our calendar carries within it a chronicle of constant change, and at certain periods has been definitely modified to make it conform to the knowledge and needs of the times.

In contemporary life commerce and industry are so highly organized, and communication and transportation have moved with such rapidity in linking the world that our calendar, even though reformed less than four hundred years ago, has become quite troublesome to use because it is not keeping step with either our knowledge or our social needs. Though there has been little *fundamental* change in the calendar since Julius Caesar, the twentieth century interrelations of industry, commerce, communication, trade, and time have given our calendar a thoroughly international character. Consequently, the improvement of the calendar is now a matter of international concern, and the informed peoples of the world are beginning to ask: "What is wrong with our calendar? What can be done about it?"

The conflicts of three different units of natural time (year, month, day) and of a fourth unit of arbitrary time (week) contributed to the eccentricities and instabilities of our civil calendar. The attempt to synchronize the four units constitutes the core of our more than 2000-year-old calendar—a calendar well entrenched in our social habits.

Our calendar, as it stands today, is inadequate to meet the needs of economic, social, national, and international relations; it is irregular in form and causes annoyance and confusion; it is impractical and inefficient to use in calculating data involving days, weeks, months, and years; it is not comparable because of the inequality of months, quarters, and half-years; and it is inconsistent because of the divergence of dates and days. Our calendar changes from year to year. Dates of events, no matter how periodically regular they may be, can never be fixed with precision without computations. Each year adjustments have to be made and schedules drawn regarding holidays. This applies to schools and colleges, government and legislature, business and trade. What a boon it would be if our ever-shifting calendar were replaced by one that would be constant from year to year! The recurring events could be fixed once and for all, and since they would fall on the same date as well as on the same day of the week, year after year, predicting them would become as simple as the use of a 12-inch rule. The adoption of such a *perpetual* calendar would eliminate much confusion and many weaknesses.

WEAK POINTS OF OUR CALENDAR

The basic weakness in our calendar is the lack of a rational division of its many components—the year, the half-year, the quarter, the month, and the week. The following list includes both causes and results of the salient weakness:

1. The year does not begin with a natural division of time at a solstice or at an equinox but at an arbitrary point. The former custom among different peoples was to start the year at a solstice or an equinox, because they mark natural beginnings for reckoning the cycle of the seasons.
2. The solar year does not contain an integral number of days; consequently the calendar year and the solar year cannot be identical from year to year. As a result of this discrepancy, some form of intercalation becomes imperative. The use of the intercalary day gives two different kinds of year; namely, common and leap years. As a result, since a year can begin on any of the seven days of the week, there are seven different kinds of common years,

and seven different kinds of leap years. All in all, there are fourteen different types of year (see Table III).

3. Our calendar year, consisting of 365 and 366 days, does not permit division into equal halves, quarters, and twelfths without leaving a fraction of a day.
4. The two halves of the year are never equal. In common years the two halves consist of 181 and 184 days, while in leap years they consist of 182 and 184 days.
5. The four quarters of our calendar year consist of 90, 91, 92, and 92 days in common years, and of 91, 91, 92, and 92 days in leap years.
6. The twelve divisions of a year are unequal in duration, irregular in sequence, and incomparable for practical purposes. Since the months consist of 28, 29, 30, and 31 days, and each month can begin on any one of the seven days of the week, there are twenty-eight different types of month (see page 17). In a year there are seven months of 31 days, four months of 30 days, and one month of either 28 or 29 days.
7. The calendar years do not contain an integral number of weeks. In common years there are 52 1/7 weeks, and in leap years 52 2/7 weeks; and thus New Year's Day regresses one day in common years, and two days in leap years. The number of weeks, likewise, is uneven in half-years, quarter-years, and months.
8. Only the month of February has an integral number of weeks in common years. The other months have 4 2/7 and 4 3/7 weeks. And in leap year February has 4 1/7 weeks. As a result, most months begin and end with a split week (see Table I). The weeks thus overlap the divisions of a year differently month by month throughout the years, and cause a multiplicity of complications in the reckoning of accounts and statistics.
9. In all months, each day of the week occurs a minimum of four times. In a month of 29 days, one day of the week occurs five times; in a month of 30 days, two days of the week occur five times; while in a month of 31 days, three days of the week occur five times (see Table I). This erratic

occurrence of the days of the week shifts from month to month and causes considerable difficulty in making statistical comparisons and calculations.

10. There is no correspondence between dates and days from week to week, from month to month, or from year to year.
11. A lack of synchronization of dates and days of the week renders the precise location of a specific occasion or event difficult. A periodic event is therefore determined either by the day of the month (July 4) or by the day of the week in the month (the fourth Thursday in November). With our calendar such designations are not precise, because if the date of the month is fixed the day varies, and if the day of the week is fixed the date varies. This situation is complicated and assumes appalling proportions in the case of Easter and other "movable feasts" which are regulated by the moon and vary greatly from year to year. There are thirty-five possible dates on which Easter can occur!

CRITERIONS OF A GOOD CALENDAR

Such are the glaring imperfections of our calendar—imperfections that make it complicated in structure, cumbersome in operation, and extremely inefficient as an instrument of reckoning time. The question then arises: What can be done to eliminate the unequal months, the unequal quarters and halves of the year, the split weeks, and the unmatching dates and days? The answer is *simplification* and *rationalization*. Application of these two principles will eliminate the undesirable, and refine and perfect the desirable.

What makes a desirable calendar? The requisite criterions of a good calendar are:

1. It should be *simple* in construction, so that each part of it can be easily understood and applied with facility.
2. It should be *precise* in measurement, so that every constituent unit of it has a sharply defined beginning and ending.
3. It should be *identical* in form to effect a synchronization of its diverse subunits and to insure a constancy of their recurrence and sequence.

4. It should be *uniform* in structure, so that its component units have consistent, comparable, and integral relationships.
5. It should be *perpetual,* so that it will be identical year after year, decade after decade, and century after century.

THE STABILIZING DAYS

To conform with the foregoing criterions, it becomes necessary to organize the year so that the days of the week will occur on specific dates from month to month, and from year to year. Such an organization could be achieved only by considering a year of 364 days as a unit of measurement, since the number 365 is not integrally divisible by seven. The number 364 can be split evenly into 52 weeks of seven days, and so is ideally suited to give uniformity and stability to the week and to the year. The three hundred and sixty-fifth day of the common year, and the three hundred and sixty-sixth day of the leap year would be beyond the pale of the newly constituted year and would be considered as annual and quadrennial *stabilizing days.*

This proposal appears to have been offered first by an Italian priest Marco Mastrofini in his book *Amplissimi frutti da raccogliersi sul calendario gregoriano perpetuo,* published in Rome in 1834.[2] He proposed the following innovations in the Gregorian Calendar:

1. A year of 364 days instead of the usual 365 days, beginning on Sunday, January 1.
2. The three hundred sixty-fifth day in common years, allocated as an extra-calendrical day, to be called *feria Octava,* pending the approval of the Church.
3. The leap-year day either to follow the Gregorian practice, or to be placed after the *feria Octava* and to be called the *intercalary day.*

Mastrofini, however, proposed no changes regarding the irregularities of the month.

The principle of a stabilizing day was also advocated by an anonymous citizen of Maryland in the issue of July, 1845, of the *Gentleman's Magazine.* Although there had been many such proposals, it was not until 1849, when the leader of Positivism, Auguste Comte, brought forward his idea of the reform of our calendar, that the concept of a stabilizing day came to be well recognized. Still later, in 1887, this idea was revitalized when it was incorporated by the French astronomer Gustav Armelin in his prize-winning 12-month, equal-quarter plan for calendar improvement. Thus the principle of the stabilizing day has been the basis of many proposals for the improvement of our calendar.

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[2] E. S. Schwegler, "Priests and the New Plan." *Journal of Calendar Reform,* Vol. IV, No. 1, pp. 9, 10, March, 1934.

SPECIFIC PROPOSALS AND TRENDS

Numerous men, both eminent and obscure, have at different times advanced proposals for the improvement of our calendar. Some of these suggestions have been for a 12-month calendar; others have set forth a 13-month adaptation. Let us review first some salient 13-month plans.

THIRTEEN–MONTH PERPETUAL CALENDAR

The idea of a perpetual 13-month calendar is not new, according to the French scholar Epstein.[3] He cites evidence to prove that Jews, centuries before the Christian Era, used in addition to their civil year of 12 months a religious year of 13 months and a month of 28 days. Such a calendar, he states, was employed in the book of Jubilees and Enoch. Another contemporary Hebrew scholar, Morgenstern,[4] contends that, even though there is "very significant indirect evidence," there is no direct reference in Hebrew literature to a month of 28 days.

In recent times, Comte is recognized as the first modern advocate of a 13-month calendar.

THE CALENDAR OF COMTE

Auguste Comte (1798-1857) attempted in his works the synthesis of scientific knowledge, which reflected the crystallization of the scientific spirit. John Morley justly appraised it when he stated: "A great analysis was to precede a great synthesis, but it was the synthesis on which Comte's vision was centered from the first."[5] Comte's synthesis was inspired by the desire to obviate the danger of denial of intellectual development to citizens who possessed the potentialities therefor. He sought to make accumulated knowledge easily available to the masses in nontechnical, everyday language. He was a proponent of the conscious fostering of habits of seeking, speaking, and dealing truthfully with self and with others, and considered these qualities prerequisites for a positivist outlook. Comte contended that man's main speculative thoughts, as well as each branch of his knowledge, pass "successively through three different theoretical conditions: the theological, or fictitious; the metaphysical, or abstract; and the scientific, or positive."[6] He stated that the theological was the beginning of the attempt of human understanding; the metaphysical was a state of transition; and the scientific was a fixed and definite state. Comte's positivism substituted humanism for dogmatic theology and highly speculative abstractions, and related it to the sphere of scientific observations. "Our real business," he emphasized, "is to analyse accurately the circumstances of phenomena, and to connect them by natural relations of succession and resemblance."[7] Recognizing that man had grasped the working of celestial and terrestrial physics and "organic physics, both vegetable and animal," he keenly felt that man needed most a knowledge of what he called "social physics." To fill this gap and to show that the sciences are "not radically separate, but all branches from the same trunk," he embarked on his encyclopedic synthesis of all inter-allied knowledge.

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[3] A. Epstein, "Le livre des Jubilés." *Revue des Études Juives*, 22:11, Paris, 1891.

[4] J. Morgenstern, "Additional Notes on 'The Three Calendars of Ancient Israel'." *The Hebrew Union College Annual*, Vol. 3, pp. 88 ff. Cincinnati, Ohio, 1926.

With such an inclusive view, Comte approached the problem of calendar improvement. In his proposal for reform he projected his views about the universality of the human spirit. Accordingly, he attempted to design a calendar that would possess the qualities of simplicity, unity, and uniformity, and at the same time be universally acceptable. Finally, in 1849, he gave to the world the standard monthly calendar, singularly simple in form. In contrast to the Gregorian, his calendar stood out like a full moon in the jumble of stars.

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[5] J. Morley, *Critical Miscellanies,* Vol. III, p. 363. Macmillan and Company, London, 1898.

[6] Auguste Comte, *The Positive Philosophy of Auguste Comte* (Trans. by Harriet Martineau), Vol. I, p. 2. George Bell and Sons, London, 1896.

[7] Auguste Comte, *ibid.*, p. 6.

His Positivist Calendar employs the principle of stabilizing days, so that his calendar year consists of 364 days or exactly 52 weeks. The year consists of 13 months, each month of 28 days or four full weeks. The three hundred sixty-fifth day of the common year and the three hundred sixty-sixth day of the leap year are without weekday names. The three hundred sixty-fifth day Comte called *Year Day* and consecrated it to "All the Dead." The Leap Day he dedicated to the memory of "Eminent Women." These annual and quadrennial stabilizing days were to be dated as the twenty-ninth and thirtieth of the last or thirteenth month of his calendar year.

Comte applied his ideas of humanism, rationalism, and scientific synthesis even to the designation of days, weeks, and months.[8] Through his calendar he sought to transmit the sense of the human evolution of thought, and to keep ever fresh the memory of the benefactors of mankind—warriors and religionists, poets and philosophers, saints and savants, healers and humanitarians, scholars and scientists. His list includes eminent men and women of all periods, cultures, and countries. In his calendar he attempted to weave the glory and the achievement of man through a schematic structure and at the same time incorporate a highly symmetrical standard of time reckoning. He desired to impress the public mind with the knowledge of the sequence of past heritage, and with a feeling of the continuity of the ages to come.

Comte named the 13 months after what he considered the world's greatest men: namely, Moses, Homer, Aristotle, Archimedes, Caesar, St. Paul, Charlemagne, Dante, Gutenberg, Shakespeare, Descartes, Frederick II, and Bichat. He named the 52 weeks after the world's next great, and the list ranges from Numa, Buddha, Confucius, Socrates, and Mohammed, through Alexander, St. Augustine, Cromwell, and Columbus, down to Bacon, Galileo, Watt, and Newton. Similarly, each day of the year was named after some outstanding personality of the ages. To avoid exclusion of great men from his list, he dedicated a number of days to two persons.

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[8] Auguste Comte, *System of Positive Polity,* Vol. IV, pp. 116–137, 346–351. Longmans, Green and Company, London, 1877.

Comte conceived this encyclopedic list in 1845 and published it in 1849. With a few exceptions, the names of the months, the weeks, and the days of Comte's calendar, constitute a veritable list of the world's 559 foremost leaders who have lived during the course of about 3,200 years. Indeed, through their lives and accomplishments one can virtually retrace, reconstruct, and interpret the entire gamut of the recorded history of mankind.

The Comtian Calendar contains four integrally multiple standards; namely, the day, the week, the month, and the year. His month was an exact multiple of the week, and his year the exact multiple of both the week and the month. With the aid of the stabilizing days he made the year perpetual. Once set in motion, it should theoretically operate without any difficulty. Comte considered it desirable to begin the week after the day of rest; therefore his weeks, as well as his months and years, begin with a Monday. According to the Comtian concept, the month as given below constitutes the central standard which repeats itself month after month, and year after year. Thus, the 28-day month virtually represents the calendar of Comte. Concerning it, John Stuart Mill has said: "In this no kind of human eminence, really useful, is omitted, except that which is merely negative and destructive." [9] Indeed, the list historically highlights the march of civilization up to A.D. 1830. Comte regarded his calendar as a balanced work of art, designed to transmit a vivid impression of the organic evolution of the culture of the race.[10]

Mon.	*Tues.*	*Wed.*	*Thurs.*	*Fri.*	*Sat.*	*Sun.*
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28

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[9] J. S. Mill, *Auguste Comte and Positivism*, 2nd ed., pp. 116 ff. N. Trübner and Company, London, 1866.

[10] F. Harrison, S. H. Swinny, and F. S. Marvin, *The New Calendar of Great Men*. The Macmillan Company, New York, 1920.

The Thirteen-Period Work Calendar. The Comtian Calendar was impressive in its concise simplicity. It stimulated considerable discussion and had a salutary effect in focusing the attention of the literati on the inadequacies of the Gregorian Calendar.

As commerce expanded and the complexities of accounting increased, the science of statistics came into its own. Statistical records became an increasingly important factor in industrial and commercial life. The month, as an intermediate unit of time between the week and the year, assumed, for purposes of comparison, considerable import to the statistician. In its essence the statistical method represents a comparison of data at different times, for different places, or for different groups of facts. Statistics embody two principles, namely, measurement and adjustment. Thus all statistical records of observed facts are related to a succession of periods of time. Since our calendar is *not* an instrument of precise measurement, any comparisons based on it obviously will be inaccurate. And as statistics began to play a key role in industrial and commercial life, in the analysis of facts, in the prediction of trends, and in the control of events, they came increasingly to be employed in records of health, disease, and death, in agriculture and industry, in science and education, and in local, state, national, and international affairs.

Many industries desired time standardization to eliminate wasteful recording and cumbersome calculations caused by the Gregorian Calendar, and to obtain comparative data relating to purchases, production, sales, costs, budgeting, labor turnover, overhead, and so forth. To many statisticians and accountants, the calendrical ideas of Comte offered promise and hope. As a result, to meet their pressing needs, they adopted the core of the Comtian idea of 13 periods, as an auxiliary calendar. This arrangement, however, leaves one extra day beyond 13 periods in common years and two extra days in leap years. There are many ways of absorbing these extra days. Any one holiday in common years and two holidays in leap years that are of least import to the business might be counted out. This method has the advantage of synchronizing the first of the auxiliary calendar year with the regular year, but the disadvantage of leaving the sequence of the beginning and ending of the week varying from year to year.

Another possible adjustment is to attach five days at the close of 208 weeks (nearly four years) to synchronize with the ending of leap year. Still another, used by many commercial firms, is to allow the extra days to accumulate for five or six years, until they add up to a week. Then, during the most inactive period, the calendar adjustment is made by inserting an extra week and counting one work period as five weeks instead of the usual four. This extra week is intercalated every five or six years, depending upon whether there are one or two leap years in that duration. In this manner the week sequence of the auxiliary calendar is maintained unbroken because the work periods will always begin and end on the same day of the week.

Under this 13-period work calendar, accounts close at the end of each 4-week period instead of at the end of the regular calendar. Billings and statements to the trade, of course, are made to conform with the customary usage of regular months. Thirteen being an odd number, it is not possible to devise exact quarterly or semi-annual financial statements in terms of periods. To obtain approximate results some companies follow the practice of breaking the thirteen work periods of the year into three, three, three, and four periods for quarters, and into six and seven periods for half-years. Regarding such a division, an advocate of this auxiliary calendar observes:

> The experience of concerns using the thirteen-period calendar shows that the advantages gained by having equal months outweigh such disadvantage as there may be in not having quarters and half-years containing a whole number of months. If it be remembered that the basic unit under the proposed new calendar is the week, more uniform than the present calendar week, it is possible under the thirteen-month calendar to have equal quarters of thirteen weeks each, and half-years of twenty-six weeks each.[11]

Companies employing this auxiliary calendar usually print special calendars for their own use and that of their employees, to indicate the division of the Gregorian Calendar into 4-week periods, with closing dates adequately marked, and the periods properly demarcated one from another. It is imperative that employees become thoroughly familiar with the calendar and remember the opening and closing dates of each period. Double standards, unless watched with alertness, contribute to complexities, errors, and confusion.

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[11] M. B. Folsom, "The Thirteen-Month Calendar." *Harvard Business Review*, January, 1930.

Aptly enough the Western Clock Company of La Salle, Illinois, pioneered the 13-period work calendar by establishing it in its plant for its accounting of business. Since 1892 it has used this calendar "for all internal records, from the purchase of raw materials to the disposal of finished products."[12] According to the American Management Association, as of January 1, 1942, a total of 1,062 companies in the United States and Canada operated under this calendrical device.

International Fixed Calendar. A slightly modified version of the Comtian Calendar, very similar to the 13-period work calendar, was advocated by a statistician, Moses B. Cotsworth.[13] Cotsworth had agitated for more than four decades for the 13-month calendar. He began by organizing the International Almanak Reform League. Later, with the sympathetic patronage of George Eastman of Kodak fame, in 1922 he initiated and guided the International Fixed Calendar League. Cotsworth's fixed calendar, like the 13-period work calendar, would consist of 13 standard months, *all identical.* In the Cotsworth Calendar, proposed in 1895,[14] the months and the year were to begin on either a Sunday or a Monday, so that the standard month would be like that of the Comte proposal, or like this:

Sun.	*Mon.*	*Tues.*	*Wed.*	*Thurs.*	*Fri.*	*Sat.*
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28

According to the Cotsworth plan, the months were to be indicated by Roman numerals (I–XIII) and not by names. If distinct names for months were deemed desirable, then the twelve zodiacal names were to be adopted, with Sol as the name for the thirteenth month. The new month *Sol* (the Sun), also representing the month of summer solstice, would be inserted between the months of June and July, and would begin on the day corresponding to our June 18 and end on what is now July 15.

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[12] L. J. Stewart *et al. Operating a Thirteen-Month Work Calendar,* p. 3. American Management Association, New York, 1928.

[13] M. B. Cotsworth, *Time to Fix the Year.* International Almanak Reform League, New Westminster, B. C., Canada, 1914.

[14] League of Nations. *Classification and Summary of Proposals for Calendar Reform,* p. 14, Geneva, 1927.

The extra day of the common year, the three hundred sixty-fifth day, would be called *Year Day* and would be numbered 29 of the thirteenth month. The *Year Day* would have no weekday name. In the same manner the *Leap Day* would have no weekday name, and would be intercalated every fourth year between the last day of June and the first day of the new month Sol. The sequence of the thirteen 28-day months, along with the intercalated days, would then correspond to the current months as indicated:

1. January
2. February
3. March
4. April
5. May
6. June (to be followed by *Leap Day* every fourth year)
7. Sol
8. July
9. August
10. September
11. October
12. November
13. December (to be followed annually by *Year Day*)

Cotsworth preferred the continuance of the Gregorian rule for leap years until A.D. 1999. In order to synchronize the calendar truly with solar time, he advocated that the year 2000 be made a common year, and that thereafter the practice of omitting a leap day every 128 years be observed. Such a practice, of course, would eliminate the Gregorian rule of centurial years regarding the leap year.

TWELVE-MONTH, EQUAL-QUARTER, PERPETUAL CALENDAR

The structure and form of the 13-month calendar was considered too radical by conventional folk. To counteract such objection, some calendar makers deemed it desirable to retain the general 12-month structure but to change the form. Such a change, they stated, would involve only minor adjustments in number of days in the different months, and still would provide a calendar having four equal quarters, year after year, in perpetuity.

The Calendar of Armelin. After Comte introduced his proposal of a new calendar in 1849, there was constant debate about it all over Europe. And as industrialization grew apace, the calendar came to play a more important part in the lives of an increasing number of people from year to year. However, Comte's proposal offered too drastic a departure from established habits and traditions to be palatable to the people. During the sixties of the nineteenth century the question of calendar reform received special attention in Germany and Russia. Later, scientists in France once more took up the matter for serious consideration.

To rouse interest and to enlist scholarship, the Astronomical Society of France sponsored a contest for the improvement of the calendar. A French astronomer, Gustav Armelin, entered the contest, his avowed aim being to retain the pattern of the Gregorian Calendar and still achieve some semblance of standardization. With this premise Armelin, in 1884, like Comte, first incorporated Mastrofini's idea of stabilizing, or blank, days in his projected plan. That left him a year of 364 days around which to construct his new 12-month structure. Then he divided the 364 days into four quarters, each of 91 days or exactly 13 weeks. He considered this 13-week quarter his basic unit. He then sought to break this basic unit into months that would compare favorably with the Gregorian months. Accordingly, he distributed the 91 days of the thirteen weeks into three months of 31, 30, and 30 days; this sequence comprised a quarter of his year. This quarter repeated four times and coupled with one stabilizing day in common years, and two days in leap years, constituted a year which was in accord with the Gregorian year of 365.2425 days. The years and quarters were to begin on a Monday and end on a Sunday. The annual stabilizing day, the three hundred sixty-fifth day, was to be dated January 0; the quadrennial leap day was to be added to the 30-day December as December 31. Armelin suggested April 7 as a fixed date for Easter. This ingenious plan of Armelin's was awarded, after long deliberation, the first prize by the Astronomical Society of France in 1887.

In 1896 M. Foerster, Director of the Berlin Observatory, and then President of the International Committee on Weights and Measures, addressed a circular to a number of scientific, religious, and political personages on the desirability of stabilizing Easter. A powerful movement for calendar reform flourished in the Balkans, where the Julian Calendar was exclusively in use at the close of the nineteenth century. The Astronomical Society and the observatory of Saint Petersburg (Leningrad) agitated in favor of the Gregorian Calendar but met stiff opposition from the Holy Synod and eventually from the Czarist administration.

Such were the cross currents in Europe following the proposal of Armelin. The people knew little about the new calendar, and still less were they organized to counteract the influence of the churches and the kings who looked obliquely, if not with avowed antagonism, at any suggestion of change, no matter how commendable.

With the advent of World War I in 1914, the little band of workers who had striven for calendrical unity in different countries of Europe was isolated. However, from the misery and the anguish of the war emerged men and women possessing perspective and vision who attempted to channelize the creative forces in order to achieve a humane and unified world. The universal, man-made contagion of sighs and tears had made sensitive people realize the kinship of man and, consequently, the pressing necessity of achieving the unity of mankind. This realization, whether conscious or unconscious, along with accelerated international trade and commerce, gave renewed impetus to the desirability of a world-recognized calendar; and, as a result, nearly all nations in eastern Europe, the U. S. S. R., Roumania, Bulgaria, Greece, and Turkey, adopted the Gregorian Calendar. This was evidence of progress; but still the problem of a simple, precise, uniform, and identical calendar, despite the contributions of Mastrofini, Comte, and Armelin, was far from settled.

The people had not been made aware of the solution even though there was an undercurrent of dissatisfaction. The calendar was not in keeping with the tempo, spirit, and routine of twentieth century industrial life. This was particularly true of the United States, where quite a large number of managers of industry introduced a 13-period calendar for internal use in their plants.

Sensing the need for a standard perpetual calendar to conform with the requirements of international intimacy wrought by swift communication and motivated by a broad and humane world-view, Miss Elisabeth Achelis assumed the leadership of the organization dedicated to calendar improvement[15] based on a revised 12-month year.

The World Calendar. Armelin's plan offered a fixed and perpetual standard. It provided a promising nucleus around which to construct a new calendar. It greatly resembled the Gregorian Calendar, which was almost universally in use. The drawback of the plan was that the quarters beginning with Monday gave 27, 26, and 25 weekdays to the three months of 31, 30, 30 days. Professor L. A. Grosclaude in 1900, like Armelin, proposed an equal-quarter plan, the year beginning on Monday, January 1, but providing for months of 30, 30, and 31 days. This arrangement gives 26 weekdays to all the months. Both these plans were deficient in that they broke into the seven-day week by beginning on the second day of the week, Monday.

Realizing that adoption of the equal-quarter plan would cause a minimum of dislocation, and recognizing that such an innovation would cause comparatively little strain to social habits and customs, Miss Achelis was convinced of the validity and pertinence of the modified twelve-month calendar advocated by Grosclaude. Since the significance of the change was of global proportions, she named the modified Grosclaude plan the *World Calendar.* Miss Achelis states that "the World Calendar gradually evolved from Switzerland as a result of a study made at the request of the International Congress of Commerce in 1914." To advance the new calendar and to familiarize the world public with its merits, she launched the World Calendar Association in 1930. In 1931 the quarterly publication *Journal of Calendar Reform* was started to supplement the educational work of the Association.

The World Calendar of 12 months and equal quarters, like the 13-month International Fixed Calendar, is constructed on a 364-day year, with similar arrangements for stabilizing days. In both, the year starts on a Sunday and ends on a Saturday. Both calendars are perpetual and repeat themselves from year to year.

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[15] E. Achelis, *The World Calendar. Addresses and Papers.* G. P. Putnam's Sons, New York, 1937.

Their similarity ends there. Unlike the International Fixed Calendar, in which a *fixed month of 28 days* is the basic unit, the fundamental unit of the World Calendar is the *quarter.* The *quarter* consists of 91 days (13 weeks) and is divided into three months—the first month of 31 days, the second and third months of 30 days each. Each quarter assumes precisely the form indicated in Table XI.

TABLE XI

THE BASIC UNIT—THE QUARTER—OF THE WORLD CALENDAR

Days	*First Month*					*Second Month*					*Third Month*				
Sunday	1	8	15	22	29		5	12	19	26		3	10	17	24
Monday	2	9	16	23	30		6	13	20	27		4	11	18	25
Tuesday	3	10	17	24	31		7	14	21	28		5	12	19	26
Wednesday	4	11	18	25		1	8	15	22	29		6	13	20	27
Thursday	5	12	19	26		2	9	16	23	30		7	14	21	28
Friday	6	13	20	27		3	10	17	24		1	8	15	22	29
Saturday	7	14	21	28		4	11	18	25		2	9	16	23	30
	26 weekdays					26 weekdays					26 weekdays				

It will be further noted that the three months begin and end on different days. The first month of 31 days begins on a Sunday and ends on a Tuesday. The second month of 30 days begins on a Wednesday and ends on a Thursday, while the third month, also of 30 days, begins on a Friday and ends on a Saturday. Hence the following quarter will begin with a Sunday and this cycle will be repeated. Thus in the World Calendar the first months of each quarter, namely, January, April, July, and October, begin on a Sunday and end on a Tuesday. The second months of the four quarters, namely, February, May, August, and November, always commence on a Wednesday and end on a Thursday. The months of March, June, September, and December must begin on a Friday and end on a Saturday. An easy way to remember this arrangement is to think: the first Sunday of the three months of each *quarter* falls respectively on the first, the fifth, and the third. Every quarter, half-year, and year begins on a Sunday and ends on a Saturday. A summary of the foregoing data is presented in Table XII.

TABLE XII

BEGINNING AND ENDING OF MONTHS AND DURATION OF QUARTERS IN THE WORLD CALENDAR

(12 months in a year)

Months begin on	*Quarters and Months, and the Corresponding Number of Days*				*Months end on*
	1st Quarter	*2nd Quarter*	*3rd Quarter*	*4th Quarter*	
Sunday	January 31	April 31	July 31	October 31	Tuesday
Wednesday	February 30	May 30	August 30	November 30	Thursday
Friday	March 30	June 30	September 30	December 30	Saturday
Total days	91	91	91	91	364 days

That plan leaves unaccounted for the two stabilizing days. In the World Calendar the annual stabilizing day (three hundred sixty-fifth day) is considered an extra Sabbath and a World Holi-

TABLE

COMPARATIVE VARIATION BETWEEN THE

	Types of Calendar	*Types of Days*	*Jan.*	*Feb.*	*Mar.*	*Apr.*
COMMON YEAR	Gregorian	Number of days in month	31	28	31	30
		Cumulative days (end of month)	31	59	90	120
	World Calendar	Cumulative days (end of month)	31	*61*	*91*	*122*
		Number of days in month	31	30	30	31
LEAP YEAR	Gregorian	Number of days in month	31	29	31	30
		Cumulative days (end of month)	31	60	91	121
	World Calendar	Cumulative days (end of month)	31	*61*	91	*122*
		Number of days in month	31	30	30	31

Italicized numbers indicate the variation from the cumulative days of Gregorian calendar.

day. It is named *Year-End Day* and is dated ***December W.*** As the name implies, it is the last day of the year and appears at the end of the fourth quarter. Since the month of December in the World Calendar has only 30 days, the Year-End Day follows December 30. The other stabilizing day appears quadrennially and is called *Leap-Year Day* and is dated ***June W,*** another World Holiday. This day is inserted between June 30 and July 1, occurs during leap years, and is also considered an extra sabbath. Thus the two "W" holidays, symbolizing world-wide unity of the human spirit and the world we inhabit, would be observed throughout the globe.

This poses the question of the range of deviation of World Calendar dates from month to month as compared with those of the Gregorian Calendar. To answer this question, it is necessary

XIII

GREGORIAN AND WORLD CALENDARS

May	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*	*Total Days*
31	30	31	31	30	31	30	31	
151	181	212	243	273	304	334	365	365
152	*182*	*213*	243		304	334	365	365
30	30	31	30	30	31	30	30 + 1 *	
31	30	31	31	30	31	30	31	
152	182	213	244	274	305	335	366	366
152	*183*	*214*	244	274	305	335	366	366
30	30 + 1 **	31	30	30	31	30	30 + 1 *	

* Indicates Year-End Day, December W.
** Indicates Leap-Year Day, June W.
} World Holidays.

to juxtapose the aggregation of cumulative days from month to month for the two calendars. Table XIII gives the comparative variation between the Gregorian and World Calendars for both common and leap years. For common years the cumulative variation is two days in February, one day in March, two days in April, and one day each in May, June, and July. For the remaining six months the cumulative days of the two calendars run parallel. During leap years the cumulative variation is still less significant. During only four months, namely, February, April, June, and July, is there a cumulative variation of a single day, while for the other eight months the cumulative days of the two calendars are identical. In regard to the comparative variation in the number of days in the months, it will be found that during common years the months of February, March, April, May, and August in the two calendars differ, while the months of January, June, July, September, October, November, and December are identical. During leap year, the months of January, July, September, October, November, and December in the two calendars concur, while the remainder of the months disagree. These data are conveniently summarized thus:

	Number of Months	
Year	*Identical*	*Differing*
Common	7	5
Leap year	6	6

A salient asset of the World Calendar is the fact that *every* month has 26 weekdays exclusive of Sundays. This facilitates comparison of most statistical data, particularly production costs, of any one month with any other month. Its greatest disadvantage lies in the fact that the months do not begin on the same day of the week. However, this handicap is made less difficult by the fact that the first month of each quarter begins on a Sunday, the second month on a Wednesday, and the third month on a Friday. Every year and each quarter begins on a Sunday and ends on a Saturday. This leads us to a comparison and contrast of the two calendars contending for priority of recognition.

THIRTEEN VERSUS TWELVE

Both the Thirteen-Month Fixed Calendar and the World Calendar have been accepted as distinctly superior to our Gregorian Calendar in terms of simplicity, precision, uniformity, and perpetuity. Both eliminate the major defects of the present calendar. Each has received considerable attention and has its enthusiastic supporters. Both plans stand out conspicuously for their definite merits. The partisan propaganda of both camps, designed to appeal to the reason of the people rather than to their emotions, has had a healthy influence in educating the public and in strengthening the movement for calendar simplification. Both offer a fixed calendar which would be identical from year to year; both synchronize the dates and the days, and reduce the calendar to a stable standard; and both equalize the quarters and halves—the World Calendar in terms of months and weeks, and the Thirteen Month Calendar in terms of weeks only. Finally, both eliminate the variability of our present calendar—a medley of twenty-eight varied types of months and fourteen different kinds of calendar years.

The Thirteen-Month Calendar calls for a drastic change, as it scraps almost entirely the present structure. Its adoption, no doubt, would create considerable dislocation in habits, customs, and practices. As 13 is an odd number, the year is not divisible into integral months by the numbers 2, 3, 4, and 6. Thus the halves, quarters, thirds, and sixths of the year would be in fractions, namely, 6½, 4⅓, 3¼, 2⅙ months. Since most business statistics are recorded in terms of half-years and in quarter-years, past records would be rendered difficult of interpretation and would need a reorientation of data, tables, and charts in terms of a 28-day month. Thus the Thirteen-Month Calendar is impractical where quarterly and half-yearly data are involved. Drastic revision of birthdays, wedding anniversaries, holidays, and historical dates would be necessary. The regularity with which Friday would fall on the thirteenth of every month would make this calendar a target of superstitious folk.[16] Many claim that the monotony of its structure would be very stifling. The shift from our present calendar to this one would involve many distinct and obvious difficulties.

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[16] This superstition is presumed to stem from the crucifixion of Jesus on a Friday, and also from the belief that thirteen persons, including Judas Iscariot, were present at the Last Supper. Friday the thirteenth has come to be regarded

On the credit side, the Thirteen-Month Calendar is simplicity at its best and hence easily calculable. Any person capable of reading and writing can easily construct it without any outside aid. The month is unchanging and contains a whole number of weeks with identical dates and days; thus it constitutes an ideal standard. This intrinsic merit would prove of utmost utility were the month rather than the quarter and half-year taken as the base unit for commercial and statistical purposes. It terminates the inconvenience of split weeks in social and industrial life. Finally, because the month is an exact multiple of the week and the year an exact multiple of both the month and the week, its usefulness as a standard is definitely enhanced. The dates and days of anniversaries, once standardized, would always be identical.

The salient disadvantage of the World Calendar is its triple standard of months. The three months of the identical quarters begin and end on different days of the week. All months are spread over five weeks (see Table XI). The first month of each quarter terminates in a split week, the third month begins with a split week, while the second month begins and ends with split weeks. The dates do not fall on the same day of the week from month to month, although they do coincide from quarter to quarter. However, the comparison of future dates with past dates would be less complicated than in the Thirteen-Month Calendar. On the other hand, four months of 31 days and eight months of 30 days contribute to the diversity of standards and, hence, to multiplicity for statistical purposes. Also, despite decided improvements, the World Calendar would still necessitate consulting the calendar to learn the days of the week for any given month.

Advocates of the World Calendar contend that, since its adoption would cause little interference with and less dislocation in habits, traditions, and associations, it would evoke little popular

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by the superstitious as an especially unlucky day. In recognition of this superstition many skyscrapers, hotels, and office buildings do not have a floor numbered thirteen.

opposition. It achieves the main objectives of a perpetual calendar with a minimum of deviation from our present one. It retains the general structure and appearance of our 12-month calendar. It violates practically none of the ingrained loyalties, prejudices, and folkways of the people. The transition to it would be so easy that it would scarcely be noticed. Only seven changes of dates would be needed: namely, two days would be added to February and one to April; a day each would be dropped (the thirty-first) from March, May, and August; and December 31 would become the stabilizing day (December W). Since the quarters are identical, the World Calendar would materially facilitate bookkeeping for quarterly, half-yearly, and yearly comparisons. It would be distinctly preferable where calculations in months are related to quarters and halves. In one respect the months of the World Calendar are identical; namely, every month contains twenty-six weekdays plus Sundays. Since the dates and days would be standardized, such anniversaries as those of births and of weddings would be identical from year to year. In short, the World Calendar provides *optimum benefit with a minimum of change.*

Since each year and each quarter in the World Calendar begins on a Sunday, the establishment of a fixed date for Easter on a given Sunday would be an easy matter. And since all liturgical feasts and Saints' days are related to Easter, they likewise would fall on fixed dates and days. In this manner, from year to year ecclesiastical feasts would coincide, and churches would greatly benefit through the orderly simplification of liturgy, cult, feasts, and Lenten devotions. Holidays in the new calendar could be arranged to fall at the most convenient time. To provide a long week end, they could be transferred to a Monday when they occur in the middle of the week. Thus the "national" holidays of the United States would be fixed to occur always, according to the World Calendar, on the following dates and the corresponding days of the week:

New Year's Day	Sunday, January 1
Washington's Birthday	Wednesday, February 22, or Saturday, February 11 (the original date of his birth by the Julian Calendar)

Lincoln's Birthday	Sunday, February 12 (to be observed Monday, February 13)
Easter Sunday	April 8, second Sunday of the month, (subject to church decision): at present it seesaws over a period of 35 days)
Memorial Day	Thursday, May 30 (or Monday, May 27)
Leap-Year Day	Extra Saturday, June W (World Holiday)
Independence Day	Wednesday, July 4 (or Monday, July 2) [17]
Labor Day	Monday, September 4 (or Monday, September 11). At present it oscillates between September 1 and September 7
Columbus Day	Thursday, October 12 (or Monday, October 9)
Election Day	Tuesday, November 7 (or Monday, November 6). In most states Election Day is a holiday and falls on the "first Tuesday after the first Monday in November"
Armistice Day	Saturday, November 11 (or Monday, November 13)
Thanksgiving Day	Fourth Thursday, November 23 (or fourth Monday, November 27)
Christmas	Monday, December 25
Year-End Day	Extra Saturday, December W (World Holiday)

The date when either of these two calendars can be most appropriately adopted deserves consideration. Because in 1944, December 30 occurs on a Saturday, December 31 could be considered a December W or Year-End Day. This arrangement would make the year 1945 begin with a Sunday for the initiation of either the Thirteen-Month Calendar or the World Calendar. The next most convenient date to introduce a new calendar would be Sunday, January 1, 1950.

Let us now analyze the Gregorian Calendar and compare it with the two proposed (equal-quarter and thirteen-month) calendars.

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[17] The Declaration of Independence was introduced in the Continental Congress on July 2, 1776, and received approval of the Congress on July 4, 1776.

THE OLD VERSUS THE NEW

Table XIV gives an analysis of our calendar year 1942 and the two suggested alternatives. It will be observed that, in the Gregorian Calendar, with the exception of February, which in that particular year had four whole weeks, every single month had split weeks. Nine months extended over five different weeks, while May and August spread over six different weeks without any regular or repeated sequence. The months began and ended on different days. The quarter-years and half-years also were uneven and unequal. The structure of the Gregorian Calendar thus is simply confounding.

In contrast to this, the World Calendar is distinctly an improvement. Each month extends over five incomplete weeks but follows a definite pattern. The first month of each quarter begins on a Sunday, the second on a Wednesday, and the third on a Thursday. Each quarter consists of exactly 91 days or 13 weeks. This quarter pattern repeats itself and results in four equal quarters and two identical halves. Both the quarter and the year of this calendar are perpetual.

In contrast to the Gregorian Calendar, the International Fixed (13-month) Calendar is strikingly simple. Every month begins on a Sunday, runs through precisely four weeks, and terminates on a Saturday. This process repeats itself thirteen times to constitute the year. Unlike the Gregorian Calendar and the World Calendar, it is devoid of split weeks. As indicated in Table XIV, each quarter-year is exactly 13 weeks in duration and hence overlaps other months. Thus in the Thirteen-Month Calendar, the first quarter runs over the first week of the fourth month; the second quarter runs over the first two weeks of the seventh month; and the third quarter runs over the first three weeks of the tenth month. All the months, all the quarters, and all the half-years are identical and are integral multiples of the week. However, the quarter-years and half-years are not integral multiples of the 28-day month. The month of this calendar is perpetual from month to month and from year to year. So is the calendar.

TABLE XIV. AN ANALYSIS OF OUR PRESENT

GREGORIAN CALENDAR
1942

WORLD
Any

Number of Week	*Weeks and Days*	1st Quarter			2nd Quarter			3rd Quarter			4th Quarter			1st Quarter			2nd Quarter		
		Jan.	*Feb.*	*Mar.*	*Apr.*	*May*	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*	*Jan.*	*Feb.*	*Mar.*	*Apr.*	*May*	*June*
First	Sun.		1	1								1		1			1		
	Mon.		2	2			1					2		2			2		
	Tues.		3	3			2			1		3	1	3			3		
	Wed.		4	4	1		3	1		2		4	2	4	1		4	1	
	Thu.	1	5	5	2		4	2		3	1	5	3	5	2		5	2	
	Fri.	2	6	6	3	1	5	3		4	2	6	4	6	3	1	6	3	1
	Sat.	3	7	7	4	2	6	4	1	5	3	7	5	7	4	2	7	4	2
Second	Sun.	4	8	8	5	3	7	5	2	6	4	8	6	8	5	3	8	5	3
	Mon.	5	9	9	6	4	8	6	3	7	5	9	7	9	6	4	9	6	4
	Tues.	6	10	10	7	5	9	7	4	8	6	10	8	10	7	5	10	7	5
	Wed.	7	11	11	8	6	10	8	5	9	7	11	9	11	8	6	11	8	6
	Thu.	8	12	12	9	7	11	9	6	10	8	12	10	12	9	7	12	9	7
	Fri.	9	13	13	10	8	12	10	7	11	9	13	11	13	10	8	13	10	8
	Sat.	10	14	14	11	9	13	11	8	12	10	14	12	14	11	9	14	11	9
Third	Sun.	11	15	15	12	10	14	12	9	13	11	15	13	15	12	10	15	12	10
	Mon.	12	16	16	13	11	15	13	10	14	12	16	14	16	13	11	16	13	11
	Tues.	13	17	17	14	12	16	14	11	15	13	17	15	17	14	12	17	14	12
	Wed.	14	18	18	15	13	17	15	12	16	14	18	16	18	15	13	18	15	13
	Thu.	15	19	19	16	14	18	16	13	17	15	19	17	19	16	14	19	16	14
	Fri.	16	20	20	17	15	19	17	14	18	16	20	18	20	17	15	20	17	15
	Sat.	17	21	21	18	16	20	18	15	19	17	21	19	21	18	16	21	18	16
Fourth	Sun.	18	22	22	19	17	21	19	16	20	18	22	20	22	19	17	22	19	17
	Mon.	19	23	23	20	18	22	20	17	21	19	23	21	23	20	18	23	20	18
	Tues.	20	24	24	21	19	23	21	18	22	20	24	22	24	21	19	24	21	19
	Wed.	21	25	25	22	20	24	22	19	23	21	25	23	25	22	20	25	22	20
	Thu.	22	26	26	23	21	25	23	20	24	22	26	24	26	23	21	26	23	21
	Fri.	23	27	27	24	22	26	24	21	25	23	27	25	27	24	22	27	24	22
	Sat.	24	28	28	25	23	27	25	22	26	24	28	26	28	25	23	28	25	23
Fifth	Sun.	25		29	26	24	28	26	23	27	25	29	27	29	26	24	29	26	24
	Mon.	26		30	27	25	29	27	24	28	26	30	28	30	27	25	30	27	25
	Tues.	27		31	28	26	30	28	25	29	27		29	31	28	26	31	28	26
	Wed.	28			29	27		29	26	30	28		30		29	27		29	27
	Thu.	29			30	28		30	27		29		31		30	28		30	28
	Fri.	30				29		31	28		30					29			29
	Sat.	31				30			29		31					30			30
Sixth	Sun.					31			30										
	Mon.								31										
Days in a quarter-year		90			91			92			92			91			91		
Days in a half-year		181						184						182					

THE STABILIZING DAYS

The *Leap-Year Day* (June W) is sandwiched between June 30 and July 1 every four years.

ALENDAR AND SUGGESTED ALTERNATIVES

LENDAR

ar

3RD QUARTER			4TH QUARTER		
July	Aug.	Sept.	Oct.	Nov.	Dec.
1			1		
2			2		
3			3		
4	1		4	1	
5	2		5	2	
6	3	1	6	3	1
7	4	2	7	4	2
8	5	3	8	5	3
9	6	4	9	6	4
0	7	5	10	7	5
1	8	6	11	8	6
2	9	7	12	9	7
3	10	8	13	10	8
4	11	9	14	11	9
5	12	10	15	12	10
6	13	11	16	13	11
7	14	12	17	14	12
8	15	13	18	15	13
9	16	14	19	16	14
0	17	15	20	17	15
1	18	16	21	18	16
2	19	17	22	19	17
3	20	18	23	20	18
4	21	19	24	21	19
5	22	20	25	22	20
6	23	21	26	23	21
7	24	22	27	24	22
8	25	23	28	25	23
9	26	24	29	26	24
0	27	25	30	27	25
1	28	26	31	28	26
	29	27		29	27
	30	28		30	28
		29			29
		30			30
91			91		
182					

The *Year-End Day* ecember W) follows cember 30 and precedes January 1 of each ar.

INTERNATIONAL FIXED CALENDAR

Any Year

1ST QUARTER				2ND QUARTER			3RD QUARTER			4TH QUARTER		
I	II	III	IV	V	VI	VII Sol	VIII	IX	X	XI	XII	XIII
1	1	1	1	1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6	6	6	6	6	6
7	7	7	7*	7	7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9	9	9	9	9	9
10	10	10	10	10	10	10	10	10	10	10	10	10
11	11	11	11	11	11	11	11	11	11	11	11	11
12	12	12	12	12	12	12	12	12	12	12	12	12
13	13	13	13	13	13	13	13	13	13	13	13	13
14	14	14	14	14	14	14*	14	14	14	14	14	14
15	15	15	15	15	15	15	15	15	15	15	15	15
16	16	16	16	16	16	16	16	16	16	16	16	16
17	17	17	17	17	17	17	17	17	17	17	17	17
18	18	18	18	18	18	18	18	18	18	18	18	18
19	19	19	19	19	19	19	19	19	19	19	19	19
20	20	20	20	20	20	20	20	20	20	20	20	20
21	21	21	21	21	21	21	21	21	21*	21	21	21
22	22	22	22	22	22	22	22	22	22	22	22	22
23	23	23	23	23	23	23	23	23	23	23	23	23
24	24	24	24	24	24	24	24	24	24	24	24	24
25	25	25	25	25	25	25	25	25	25	25	25	25
26	26	26	26	26	26	26	26	26	26	26	26	26
27	27	27	27	27	27	27	27	27	27	27	27	27
28	28	28	28	28	28	28	28	28	28	28	28	28*
91				91			91			91		
182							182					

THE STABILIZING DAYS

The *Leap Day* would be intercalated, every fourth year, between the last day of the sixth month and the first day of the seventh month, Sol.

The *Year Day*, numbered as the 29th day of the thirteenth month, would be observed every year.

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* Indicates the termination of 13-Week Quarter.

OTHER PROPOSALS FOR CALENDAR IMPROVEMENT

Numerous plans have been advanced for the improvement of the calendar, plans which embody every conceivable idea of change. They range from the suggestion of increasing the length of February to decreasing the length of the year. It is not possible to present all of them here. However, the skeleton outline of a few salient ones will be given to provide an idea of their variety.[18]

John Robertson plan. This plan sets aside two stabilizing days and considers the year as consisting of 364 days. It retains the 12 months and breaks the year into four quarters. Each quarter of 13 weeks consists of two short months of 4 weeks each, and a long month of 5 weeks. According to this scheme, there would be eight months of 28 days and four months of 35 days in each year.

Alexander Philip plan. This plan is based on the idea of preserving the continuity of the weekdays and retaining the present basis of common and leap years. The only change it proposes is to take a day away from August and attach it to February.

Metric calendar plan. This proposal is as radical in structure as it is in scope. It starts with a week of five days so that in common years there will be exactly 73 weeks. It divides the year of 365 days into 10 months. The months are of two kinds; namely, 36 and 37 days each. Thus there are five months of 36 days and five months of 37 days appearing alternately. The plan also proposes to change the number of hours in a day along with the fractions of the hour, and make them conform to a decimal system.

The Black plan. This scheme advocates an ordinary year of 52 weeks and four quarters of 13 weeks each, each quarter consisting of one month of 35 days (5 weeks), and two months of 28 days (4 weeks) each. The one surplus day of the common year and the two surplus days of the leap year are then permitted to accumulate to a week. Such a leap week is intercalated every five or six years alternately, and makes the leap year of 53 weeks or 371 days.[19] This calendar preserves the continuity of the week, but the diversity of its months definitely impedes its usefulness.

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[18] For a detailed discussion of various suggestions, consult U. S. House of Representatives, Committee on the Judiciary, *Modification of the Calendar:* Hearing on H.R. 3178, pp. 23–25, 67th Congress, Second Session, Feb. 9, 1922. Also, *Classification and Summary of Proposals for Calendar Reform,* League of Nations, Geneva, 1927.

Searle plan. An ingenious suggestion was offered by the priest-astronomer George M. Searle,[20] who found that the Gregorian cycle of 400 years consists of exactly 20,871 weeks. If there were 52 weeks in a year, there would be 20,800 weeks in 400 years. That would leave 71 weeks unaccounted for. He reasoned that with a year of exactly 52 weeks as a standard, it would be necessary to intercalate 71 weeks in a period of 400 years. He therefore proposed to have in every 400 years 71 leap years of 53 weeks each (371 days), and 329 common years of 52 weeks each (364 days). For the location of the leap years he devised the rule that all years whose numbers end in a 5 or 0, with the exception of those that end in a 50 or 00, shall be leap years. In this manner he proposed to retain the sequence of the weeks and assure uniformity of the calendar. Searle advocated this plan particularly to make every date of the year fall on the same day of the week year after year.

With these plans as a background, let us now see what serious consideration the calendar has received as an international instrument.

CALENDAR REFORM AND THE LEAGUE OF NATIONS

With the close of World War I the problem of calendar reform was again brought to public notice and discussion steadily increased under the impetus of commercial, industrial, and scientific associations. In most points of contact the world was welded together and had become interdependent. The question of the calendar had assumed an international scope and character. Therefore, because any change was ultimately a concern of all countries, the League of Nations in 1923 initiated a serious study of calendar reform.

The Special Committee of Enquiry into the Reform of the Calendar of the League of Nations in 1926, in Geneva, received

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[19] F. A. Black, *The Calendar and Its Reform*, pp. 44 ff. Gall and Ingals, London, 1932.

[20] G. M. Searle, *Publications of the Astronomical Society of the Pacific*, Vol. XXIV, No. 142, pp. 161-162, June, 1912.

185 plans from thirty-three different countries.[21] This was evidence of the keen and widespread interest which the matter had evoked in different parts of the world, from Algeria to Uruguay. The Committee based its report on extensive study and on responses to a series of questionnaires which it had issued to member governments of the League, to religious dignitaries, to numerous associations representing finance, industry, commerce, communication, transportation, agriculture, science, and labor. The Committee felt it could not recommend a reform designed to make the year begin on December 22 in place of January 1, even though such a proposal contained the intrinsic advantage of having the civil year coincide with the astronomical year. It also felt that it could not recommend any alteration in the length of the year as fixed by the Gregorian Calendar. It recognized that the 12-month equal-quarter plan and the 13-month 28-day plan would completely rectify the variability of the Gregorian Calendar. Yet the Committee took notice of the fact that the adoption of either arrangement would break the continuity of the week and therefore would be repugnant to certain religious minorities to whom observance of the week was a basic tenet. However, the Committee concluded that, from the point of view of dogmatic theology, there was little opposition either to improving the calendar or to stabilizing Easter.

The Committee stated that, on the basis of greater utility from the point of view of statistics and commerce, the 13-month system would appear to be desirable if the month, rather than the quarter, were to be taken as a unit for computation. On the other hand, the 12-month equal-quarter plan was obviously preferable if the quarter, rather than the month, were to be used. The Committee's preliminary inquiry indicated that various governments, because of the minimum of disturbance to set customs, were favorable to the 12-month equal-quarter system. Later the League urged the member nations to appoint special committees to study the problem of calendar improvement.

As early as 1910, European chambers of commerce had discussed the problem of calendar reform in London. In the United

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[21] League of Nations, *Report on the Reform of the Calendar*, p. 13. Geneva, 1926.

States, in 1918, a bill (H.R. 11486, 65th Congress, 2nd Session) by J. M. C. Smith for the reform of the calendar was introduced. The powerful International Chamber of Commerce, in its sessions of 1921 in London, of 1923 in Rome, and of 1925 in Brussels, had gone on record for a fixed date for Easter and for reform of the calendar. In a subsequent congress, held in Amsterdam in 1929, the Chamber lauded the League of Nations for its work and urged it to convene an international conference "to secure without further delay the improvement for which the world's commerce has so often asked." In such an international conference reports from various countries would be examined.

Among other international bodies, the International Astronomical Union "Commission 32," in 1922 recommended a perpetual 12-month equal-quarter calendar. The Committee for Maritime Metrology in 1926 also favored the adoption of this plan.

The National Committee on Simplification of the Calendar in the United States, headed by George Eastman, conducted three inquiries and drew up two reports, the initial one in 1929 and the supplementary one in 1931. A questionnaire elicited 1,478 replies from clergymen of fifteen different religious groups. The questions posed and the results obtained are given in Table XV.[22]

TABLE XV

RESPONSE TO QUESTIONNAIRE

	Percentage of Replies	
Questions	*For*	*Against*
A. Do you favor calendar simplification, and if so, do you favor the adoption of a fixed, perpetual, and uniform calendar?	70	30
B. Do you see any objection on religious grounds to such a calendar causing the occurrence of one 8-day week each year and two such weeks in leap years?	76	24
C. Do you favor the fixation of Easter?	80	20

The data of Table XV include the responses of Seventh-Day Baptists and Seventh-Day Adventists, who are in principle opposed to calendar reform. In June, 1931, a committee of experts, known as the Preparatory Committee and representing fourteen different countries, met for five days in Geneva. The task of this Committee was to analyze, classify, supplement, and summarize the result of inquiries made by several national committees in order to facilitate the work of the forthcoming International Conference. Of the sixteen national committee reports, thirteen were in favor of a perpetual calendar and a majority of them preferred the 13-month plan.[23] Mr. Eastman himself was an active and ardent advocate of the 13-month plan.

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[22] National Committee on Calendar Simplification for the United States, Supplementary Report, p. 42. Rochester, N. Y., 1931.

The Preparatory Committee was followed by the Fourth General Conference of the League on Communication and Transit, which was held in August, 1931, and was composed of delegates from forty-two countries, including the United States. Mr. Cotsworth was a member of the Canadian delegation. The International Fixed Calendar was also supported by the unofficial United States Committee on Calendar Simplification. Miss Achelis was the sole United States spokesman for the World Calendar, but was not a member of the American committee. The Conference felt, by a decisive majority, that because of the lack of public interest, the time was not propitious for reform, although it clearly recognized that the Gregorian Calendar has distinct disadvantages. The Conference deemed it desirable, in principle, to have a more accurately appropriate calendar to meet the needs of modern social and economic life, and took cognizance of the two outstanding contenders for the role of the successor to the Gregorian Calendar, namely, the Thirteen-Month Calendar and the 12-month equal-quarter calendar. Regarding these two rivals and their respective merits, the Conference stated:

> Most delegations thought that the thirteen-month calendar was theoretically more perfect, particularly if appropriate measures could be contemplated for the purpose of safeguarding existing contracts during the transitional period, but most of them also held that the perpetual calendar of 12 months possessed the advantage of disturbing acquired habits to a much smaller extent.[24]

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[23] League of Nations, *Fourth General Conference on Communication and Transit, Preparatory Documents,* Vol. I, *Calendar Reform,* p. 14, Geneva, 1931.

[24] League of Nations, *Records and Texts Relating to the Fourth General Conference on Communications and Transit,* Vol. I, *Calendar Reform,* p. 70, Geneva, 1931.

From the religious point of view, representatives of the Orthodox Jews and Seventh-Day Adventists opposed the idea of a perpetual calendar on the ground that it violates the continuity of the week that God created. The Conference recommended the stabilization of Easter on the Sunday following the second Saturday in April. (The Vatican later declared that this proposal must receive the approval of the Oecumenical Council.) Realizing that any reform of the calendar must be put into practice simultaneously throughout the world, the Conference encouraged education and propaganda to enlighten world public opinion before taking a definite step. Any decisive recommendation for the revision of the calendar, therefore, was deferred.

In the January, 1937, session of the League Council, the Chilean representative urged the adoption of the World Calendar. On the advice of Maxim Litvinoff, *Rapporteur* of the League's Transit Commission, the Council referred the matter to the Communications and Transit Committee. That Committee immediately communicated with all the member governments and solicited their observations regarding the proposal. By September, 1937, out of sixty-nine governments approached, thirty-two had forwarded their views. Following is the summary of their views regarding the World Calendar:

	Number of Governments
Approve in principle	10
Definitely opposed	5
No observation	6
Not prepared to make a decision	7
Considered premature	4

The government of the United States of America had no observation to make regarding the Chilean proposal. However, it wished to be kept informed of developments. By January, 1938, forty-five governments had responded to the League's inquiry, and the roster of nations stood as shown in Table XVI.[25]

This comprises the stand of forty-five governments in regard to the World Calendar about the close of the year 1937. Of those

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[25] *Journal of Calendar Reform,* Vol. 8, No. 2, pp. 71–73, June, 1938.

TABLE XVI

THE STAND TAKEN BY THE DIFFERENT GOVERNMENTS ON THE WORLD CALENDAR

Position regarding the World Calendar	*Countries*		
Approving the World Calendar	Afghanistan	Mexico	
	Brazil	Norway	
	Chile	Panama	
	China	Peru	
	Esthonia	Spain	
	Greece	Turkey	
	Hungary	Uruguay	14
Definitely opposing the World Calendar	Argentina	Holland	
	Haiti	Roumania	
	India	Sweden	6
No observations to submit	Australia	Lichtenstein	
	Denmark	Siam	
	Iceland	United States	
	Iraq	Venezuela	8
Unable to make a decision	Bulgaria	Guatemala	
	Czechoslovakia	Latvia	
	Egypt	Lithuania	
	Ecuador	Switzerland	
	Finland	Union of Soviet Socialist Republics	10
Consider premature to introduce reform	Austria	New Zealand	
	France	Poland	
	Monaco	South Africa	
		United Kingdom	7

answering, 31 per cent favored the World Calendar, about 13 per cent definitely opposed it, while the remainder, 56 per cent, were either noncommittal or considered the reform premature.

As the days went by and World War II approached, the times and circumstances became more and more unfavorable for further international collective consideration for calendar change. However, the contest between the two calendars goes on unimpeded.

World War II is doing an even more effective job than World War I in making the peoples of the world realize the innate unity of mankind; and the calendar, along with standard time, is penetrating heretofore secluded parts of the world.

CHAPTER V

CONCLUSION

> *"Society influences, inspires and directs science quite as much as science transforms society. All of the great discoveries and inventions of the past, the telescope, the steam engine, the theories of gravitation and of evolution, are themselves just as much products of society and economic forces as they are factors in social change. The history of science must become a vital part of science teaching, and on the other hand, the understanding of science and of its social importance must enter into all historical courses."* [1]
>
> —J. D. BERNAL

THE PURPOSE of this study has been to present the historical perspective, the pertinent facts, and the two salient alternative solutions relating to the problem of changing the calendar. The two projected solutions need to be considered on their merits. Individual judgment based on deliberate thought can best contribute to sound public decision concerning desirable changes.

The scientific attitude and the scientific method need not be restricted to the laboratory. They should be extended and applied to everyday life. Democracy will be nurtured directly in proportion to the degree in which its adherents apply scientific methods to everyday life. A practical knowledge of the scientific method is the crying need of good citizenship. In the cultivation and use of this knowledge and skill, the teacher can be of incalculable help.

Scientific objectivity, combined with humanitarianism, provides excellent techniques to help us solve our social problems. In a democracy, as in science, debates, analyses, tests, and criticism are not only desirable but indispensable. One of the most distinguishing features of a democracy is its willingness and ability to face the ugly sore spots, to lance and clip them from the body politic, and to stop their infection and contagion. It is this characteristic which, if utilized, enables a democracy not only to survive a crisis but even to emerge from it reinvigorated.

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[1] J. D. Bernal, "Science Teaching in General Education." *Science and Society,* Vol. IV, No. 1, p. 4, Winter, 1940.

Thus in a democracy it is the privilege and duty of each citizen to study matters relating to the general welfare and then to exercise his rights of suffrage. Unless every citizen weighs the facts, analyzes the situation, and passes his judgment through his vote, democracy will not function to its full capacity. The critical judgment of the citizen needs to be implemented by a corresponding action. "Thought that does not end in action," Romain Rolland observed, "is an abortion and treachery."

The idea of improving the reckoning of time was inherent in the first time-concepts of our prehistoric ancestors and can be considered to be as old as the very first calendar. In each stage of civilization, changes have resulted from the shifting needs of dominant groups. So long as the calendar remained an instrument of exclusive control and ownership, its structure and constitution were arbitrarily interpreted, amended, and revised by kings, dictators, pharaohs, prophets, priests, popes, pundits, and pontifices to suit their whims and interests, and nobody objected. However, once the calendar came to be widely used by the populace as a vital instrument related to everyday life, even potentates had to reckon with public opinion before effecting change. With expanding democratic horizons and correspondingly contracting authoritarianism, and with the use of the calendar becoming more universal, further changes in it will come in response to public demands. Because the great majority of mankind is made up of farmers and workers whose lives are intertwined in the daily march of the calendar, changes will be brought about only when the masses of people are convinced of their validity and necessity. Change will not come by the mere fiat of some dignitary, as in past ages, nor by the writing of learned treatises.

Change has been the unchanging rule in nature, as it is in human affairs—in the arts, sciences, cultures, politics, folkways, and the calendar. The calendar is an instrument conceived from the very beginning to serve human needs and to bring about the adjustments demanded by new knowledge. The history of scientific measurement is replete with examples where false or only approximate methods have been repeatedly replaced by more exact ones. As we have seen, this holds true of our calendar too. Indeed, it is an instrument that has seen a minimum of mutation;

nevertheless, it *has* been changed within the last two millenniums by Julius and Augustus Caesar and by Pope Gregory XIII. We have seen how men, inhabiting the same earth, exposed to the same sun, finally were compelled by the necessities of common interests to construct a common calendar. In an interrelated world, made more intimate by global commerce and war, the need for a monolithic calendar becomes increasingly pressing. In reality the United Nations from China to the United States, by and large, follow the same calendar, as they do standard time. That holds true for the Axis powers too.

We have seen how man extracted knowledge from nature—his environment at large—and adapted it to his needs. By crude and refined experimentation with his gleanings from investigation of the world about him, his knowledge eventually effected a change in him and in his society. This constant interaction brought about modifications, not only in man's skills, tools, and techniques, but also in his social theories and practices. Nor did this progressive change and interaction imply impermanence or destruction of the society which man had evolved. Rather a flexible society which is responsive to the exigencies of the commonweal and predicated by man's increasing knowledge of himself and his world will be more stable and permanent than a rigid and static society.

In the realm of human relationships, discontent and imagination are the parents of change; democratic instrumentalities provide the channels through which discontent can be transformed into creative activities. Thus democracy provides a framework within which scientific principles can be applied to human relations. Democratic institutions provide facilities for adequate adjustment in the interest of the general welfare.

We have seen that our calendar is a product of the cross-fertilization of many cultures and ages and represents a concentrate of certain experiences of the race. It was not divinely ordained, nor was it created by some benevolent extra-human dictator. It grew out of human needs and assumed new forms with man's increasing experience and expanding knowledge. It is compounded of the influences of renaissance, reformation, and revolutions, not only of recent years, but from immemorial times.

In a functioning democracy no *dictatorial* changes are required or desired. A change necessarily comes when the people are convinced of its desirability. Once an informed public has given its mandate, the change is made, and only the technical details and administration are matters for experts. In our present world, changes in our calendar will be made only when a democratically active and informed public opinion demands them.

There is nothing sacrosanct about the calendar, nor does it possess any infallibility. It is primarily an instrument devised by man to serve him rather than to enslave him. Our lives, relationships, and enterprises are beneficially organized or injuriously disorganized by the efficiencies or inefficiencies latent in the operational characteristics of our calendar. We have seen how the calendar has been amended, revised, and overhauled, time and again, through the short history of two millenniums. The current demand for further revision is supported by ecclesiastical, governmental, business, social, educational, scientific, and labor groups. This demand is greatly accentuated by the product of the power and air age; the increasing exchange of raw materials and finished goods has been made possible by speedy transportation, the sharp rise in international intercourse, and the consequent rapid transit of ideas through electric communication. The same international exigency that brought about the adoption of the Hindu numerical notation transmitted to Europe by the Arabs, almost world-wide adoption of the Gregorian Calendar, recognition of the metric system in the scientific world, the universal recognition of the Greenwich meridian and the international date line and the adoption of standard time, is beginning to rise and to force revision of the calendar. Before World War II, the demand for calendar revision in the League of Nations was supported by representatives of fifty different countries.

Few would insist upon the use of an old-time watch if an up-to-date chronometer were accessible. Such is the case with our calendar. The calendar needs to be brought into line with our best scientific knowledge of time. This has been done in the past, as in the case of the Julian and the Gregorian Calendars. The

Julian Calendar was like an old clock running faster than astronomical time. To a lesser degree this holds true for our Gregorian Calendar. When an old timepiece is no longer accurate, we replace it by a better one as soon as we can afford it.

Today the calendar is considered indispensable by peoples and their governments the world over in the exigencies of world planning, to the end of concluding a speedy and successful war for the liberation of all peoples from economic, social, racial, and political oppression. We look to a world of tomorrow, according to Henry A. Wallace, Vice-President of the United States,[2] peacefully operated by and for common men who will be working and planning together for a democratic globe. Unless the old timepiece is replaced, we shall be using an obsolete and inefficient instrument for projecting our twentieth century global plans.

It would seem logical, therefore, to suppose that in a world rapidly contracting in space and time—the aptly designated *One World* of Wendell L. Willkie[3]—animated by common aspirations, linked by common ties, marching toward common goals, our aims might be realized more speedily if we were to perfect our tools, instruments, and techniques to conform to our present knowledge. One of these is our calendar. It needs to be simplified and standardized. The adoption of such steps would facilitate easy acceptance of a reformed calendar the world over. Then the old calendar could well find a repository in a museum and take its place with other antiquities the better to furnish an historical perspective to posterity.

> "Discussion, elucidation, the light of a thousand minds brought to a focus—these will result in discarding the worst and in improving the best."—*Horace Mann*

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[2] Henry A. Wallace, *Century of the Common Man.* Reynal and Hitchcock, New York, 1943.

[3] Wendell L. Willkie, *One World.* Simon and Schuster, New York, 1943.

APPENDIX A

HOLIDAYS OF THE UNITED STATES

From early days man has celebrated his periods of time after some outstanding events. In earlier periods the ascension of kings to their thrones was an important reference in time reckoning and chronology in general. Such were the Chinese era of Yao, the Babylonian era of Nabonassar, the Hindu era of Vikramaditya, and the Roman Julian and Augustan eras. Still other eras were named after great religious leaders, namely, the Buddhist, the Christian, and the Mohammedan eras.

In recent times, however, the events which have advanced the well-being of the masses of people have come to be recognized as significant points of time reference. The English Revolution and the transfer of political authority to Parliament, the American Revolution and the Bill of Rights, the French Revolution and the abolition of feudal rights, and the Russian Revolution and the establishments of the Soviets have punctuated our recent history and have had profound influence in our thoughts and lives. The dates of these events are marked as national holidays.

Significant memorable events are thus celebrated in various countries. A brief consideration of the most important "national holidays" observed in the United States follows.

Lincoln's Birthday. In each age, man's irrepressible craving for relief from subjugation and tyranny has found expression through the work and achievement of some great personality. Abraham Lincoln's life symbolizes this aspiration of the human spirit. The emancipation of the slaves, a movement of which Lincoln was the martyred leader, and the preservation of the Union are commemorated by a grateful nation on his birthday. The observation was begun in 1887. Most of the Confederate states, however, do not observe this day as a holiday.

Lincoln was born on Sunday, February 12, 1809. February 12, like any other date, can occur on any of the seven days of the week and drifts from year to year. The table following indicates the days of the week on which this holiday has fallen or will fall in the various years, starting from 1900 and going through the twentieth century, if the Gregorian Calendar is not reformed.

Washington's Birthday. George Washington's birthday commemorates the achievements of the new republic under the leadership of its first commander-in-chief and first president. Now we celebrate his birthday on February 22. But actually he was born on Friday, February 11, 1732, according to the Julian or Old Style Calendar which preceded the present Gregorian Calendar and at that time was in use in all the British colonies. The Roman Catholic countries had preceded Protestant England in adopting the "papal" calendar. Eventually, the exigencies of her rapidly expanding trade and communication with continental Europe prompted England also to adopt the Gregorian Calendar. When Britain adopted the New Style or Gregorian Calendar in 1752, the American colonists followed suit. By that year the Julian Calendar had fallen eleven days behind the Gregorian Calendar. To compensate for this discrepancy, the dates were advanced eleven days. Therefore Washington's birthday is celebrated on February 22 and not on February 11.

Although Washington was born on a Friday, we celebrate his birthday on any of the seven days of the week, depending on the year. Thus, in 1940, it fell on Thursday, in 1941 on Saturday, in 1942 on Sunday, and in 1943 on Monday. Without adequate calculation, one cannot easily tell on just what day of the week his birthday would fall. In the table giving the birthdays of Lincoln, if we substitute Wednesday for Sunday, Thursday for Monday, Friday for Tuesday, and so on, we shall obtain a corresponding table indicating the days of the week on which Washington's birthday would occur during those years.

Memorial (Decoration) Day. Memorial Day grew out of the Civil War. Three years after the Civil War, by his General Order of May 5, 1868, John A. Logan, Civil War general and commander-in-chief of the Grand Army of the Republic, designated May 30 as a time to honor "the Comrades who died in the defense of their country during the last rebellion." He set this day aside for the purpose of decorating with flowers the graves "of those who had fallen in that historic struggle."

Most of the Southern states observe a corresponding occasion called Confederate Memorial Day, but the date is not uniform.

THE DAYS OF THE WEEK ON WHICH LINCOLN'S

Sunday		1905	1911		1922	1928	1933	1939
Monday	1900	1906	1912	1917	1923		1934	1940
Tuesday	1901	1907		1918	1924	1929	1935	
Wednesday	1902	1908	1913	1919		1930	1936	1941
Thursday	1903		1914	1920	1925	1931		1942
Friday	1904	1909	1915		1926	1932	1937	1943
Saturday		1910	1916	1921	1927		1938	1944

(Note: It will be observed that, since 1900 was not a leap year in the Gregorian days of the week; otherwise the years are grouped in fours, each group ending in a consequently the following year the same date occurs one day (of the week) later, because the year contains two days in excess of fifty-two weeks.)

In Alabama, Florida, Georgia, and Mississippi it is celebrated on April 26; in North and South Carolina and Kentucky, on May 10; in Louisiana and Tennessee, on June 3, the birthday of Jefferson Davis, the Confederate president. However, in many communities of the South, both Memorial days are being observed.

Later, this custom was observed by the veterans of the Spanish-American War in 1899. Still later, in 1919, the survivors of World War I, who fought on the fields of Flanders, adopted the occasion to pay homage to their dead comrades. In the future it will, no doubt, include the men and women who have sacrificed their lives on six continents and in seven seas in World War II. This date, likewise, can fall on any of the seven days of the week.

Independence Day. Important signposts punctuate the history of man. Independence Day is such a signpost and commemorates man's undying love of freedom. During the opening months of the year 1776, Thomas Paine released his pamphlet *Common Sense,* advocating independence without fear and without apology. This forcefully written classic was most effective propaganda, because in it Paine reflected the consensus of the people's opinion and gave lucid expression to their legitimate aspirations. The pamphlet prepared the public for the struggle which culminated

BIRTHDAY FALLS IN DIFFERENT YEARS

	1950	1956	1961	1967		1978	1984	1989	1995
1945	1951		1962	1968	1973	1979		1990	1996
1946	1952	1957	1963		1974	1980	1985	1991	
1947		1958	1964	1969	1975		1986	1992	1997
1948	1953	1959		1970	1976	1981	1987		1998
	1954	1960	1965	1971		1982	1988	1993	1999
1949	1955		1966	1972	1977	1983		1994	2000

Calendar, the Lincoln days in the five years from 1900 to 1904 occurred in successive
leap year. The reason is that in a common year we have fifty-two weeks and one day;
Likewise, following the leap year the same date occurs two days (of the week) later

in the Declaration of Independence drafted by Jefferson. On July 2, 1776, the Congress went on record as declaring independence. Two days later, July 4, the amended final draft of Jefferson's historical masterpiece was formally adopted. Since then this date has symbolized the liberation of a people from a tyrannical monarch and is fittingly celebrated in all forty-eight commonwealths, the colonial territories, and possessions of the United States.

In 1942, the Fourth of July fell on Saturday, being a fixed day in a drifting calendar, and on Sunday in 1943. When a holiday falls on a Sunday, the following day commonly is celebrated, which practice is some evidence of our general recognition of the inadequacy of the calendar.

Labor Day. The first of May is generally used by the trade unions and labor organizations the world over to symbolize the solidarity of all who labor for their living. The day originated in the United States on May 1, 1886, when the Knights of Labor called a general strike for the eight-hour day. Six years later, on

June 28, 1894, the Congress of the United States passed a bill designating the first Monday of September as Labor Day; all of the states, by legislation, have conformed to that day. It is marked by the general cessation of industrial activity and is celebrated with parades, meetings, picnics, athletic events, and other gala activities by organized labor. Labor Day also marks the close of the summer season and unofficially inaugurates the revival of indoor activities and the reopening of most educational institutions. Designating "the first Monday of September" as Labor Day makes it occur anywhere from September 1 to September 7. In 1941, Labor Day occurred on the first, while in 1942 it occurred on the latest possible date, the seventh of September.

Columbus Day. The rediscovery of the New World by the Italian cartographer, Christopher Columbus, in recent times, is described as "the most important event which has occurred since the advent of Jesus Christ." Columbus Day is dedicated to the memory of this dauntless pioneer, a fearless explorer, and an adventurous navigator, who negotiated a broad, unruly ocean in a mere "cockleshell" of a ship, at a period when the wisest captains hugged close to the shore on their trips. His search for a short route to the coveted wealth of India opened a new epoch in the knowledge and growth of man.

Columbus departed from the port of Palos on Friday, August 3, 1492, and sighted the first stretch of land on the western hemisphere on Friday, October 12, 1492.[1] Both these dates are in accordance with the Julian reckoning, since the Gregorian Calendar was introduced in Rome and the Catholic countries ninety years after the discovery of America. Columbus landed on an island which the natives called Guanahani; he renamed it San Salvador. Here he unfurled the flag of Spain above his crew of many nationalities—the culmination of a collective struggle symbolic of the melting pot that was to furnish future America with vitality and the spirit of adventure.

It was in salute to such spirit and to "the pioneer of progress and achievement" that President Benjamin Harrison, on the fourth centennial of the discovery of America, in 1892, dedicated

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[1] S. E. Morison, *Admiral of the Ocean Sea,* pp. 154 ff. Little, Brown and Company, Boston, 1942.

October twelfth as a holiday. This day is now observed in practically all the states of the Union, and is celebrated in most of the Latin American republics. Columbus Day is also known as Fraternal Day in Alabama, Discovery Day in North Dakota, and Landing Day in Wisconsin.

Like any other fixed date, Columbus Day occurs not on Friday, but on any of the seven days of the week.

Election Day. This is the day on which citizens assert their rights, obtained through a long chain of hard-fought struggles, and thereby contribute their share to the expression called "the voice of the people." Whitman, the bard of democracy, called it "the still small voice vibrating—America's choosing day." [2] It is a day that reminds a citizen of his civic rights and responsibilities, a day on which, through the secret ballot, he subscribes to the collective will and weal. In doing so, the contemporary citizen in a democracy asserts his dignity and authority in contrast to the power of the dictators and kings of other nations. As America's poet of freedom, Whittier, has written:

> To-day alike are great and small,
>   The nameless and the known;
> My palace is the people's hall,
>   The ballot-box my throne.[3]

Election Day is a reminder of the call to arms on which the American republic was established, namely, "no taxation without representation."

In most states, Election Day is a holiday and falls on the "first Tuesday after the first Monday in November." The roundabout and awkward phraseology required here to fix a specific day is itself an indictment of the calendar as it is now constituted. Despite this specification, one must inevitably leaf through the pages of the calendar to determine the date of Election Day. The earliest election date is, therefore, November 2, and the latest is November 8. Thus Election Day can occur on any date between November 2 and November 8, inclusive.

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[2] Walt Whitman, "Election Day, November 1884." *Leaves of Grass,* p. 500. David McKay, Philadelphia, 1900.

[3] "The Poor Voter on Election Day." *The Complete Works of John Greenleaf Whittier,* Household Edition, p. 458. Houghton Mifflin Company, Boston, 1904.

Armistice Day. November 11 commemorates the cessation of hostilities between the Allied Powers and Germany in World War I. On that day, in 1918, the German military leaders went to a railway car, the headquarters of Marshal Foch, in the forest of Compiègne, France, and signed the armistice. The day is observed in most of the Allied countries, and it has been observed in the United States since 1921. It is a day appropriately marked by campaigns for the relief of war veterans in all the states of the Union. This date can occur on any of the seven days of the week.

Thanksgiving Day. This day is a legacy of the Pilgrims and symbolizes the tradition of ages before them. The first Thanksgiving was celebrated on Friday, November 9, 1621 (Old Style, Julian Calendar), when Governor Bradford of Plymouth proclaimed it in gratitude for a successful harvest. The next recorded Thanksgiving was observed on July 30, 1623 (Julian Calendar). Early records indicate that Thanksgiving was observed irregularly. During the Revolutionary War, Congress designated the following dates for Thanksgiving:

Thursday	July	20, 1775
Friday	May	17, 1776
Thursday	December	18, 1777
Wednesday	April	22, 1778
Thursday	May	6, 1779
Wednesday	April	6, 1780
Thursday	May	3, 1781
Thursday	April	25, 1782

This historical evidence indicates the random selection of the day for Thanksgiving.[4] It was not until the Civil War that any definite day was set for its observance. By a Presidential proclamation, Lincoln, in 1864, designated Thanksgiving as the "last Thursday in November." Since then this day has been followed as the traditional Thanksgiving.

Because Christmas follows Thanksgiving so closely, businessmen, with the view of lengthening the shopping season, urged the President of the United States to shift Thanksgiving Day a week earlier. In 1939 President Roosevelt proclaimed that the "next to the last Thursday in November" be observed as Thanksgiving. This innovation was also followed in 1940 and 1941. Although the majority of states conformed to the Presidential decree, some governors refused to break with tradition and proclaimed the usual Thanksgiving. A few states celebrated both the traditional and the new. This situation caused a great deal of confusion and was capitalized on by politicians and political parties. As a result, the Congress passed a bill stabilizing the Thanksgiving as the *fourth Thursday in each November,* which was signed by the President on December 26, 1941. This new arrangement would cause Thanksgiving to occur on a date anywhere from November 22 to November 28, inclusive.

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[4] For an extended discussion, see the article "Change in Thanksgiving Day," by Elisabeth Achelis in *Journal of Calendar Reform,* Vol. 9, pp. 118–125, August, and September, 1939.

The occurrence of Thanksgiving in the middle of the week will continue to be an inconvenience so far as the continuity of a working week is concerned. Since the trend is now toward a five-day week, it would be more logical if this day were observed on Friday or Monday, thereby providing a continuous three-day week end. Thanksgiving thus would become a blessing to both the employee and the employer, inasmuch as it would give the former a desired long holiday and the latter would avoid an awkward break in the working week. In large industries, for example, the expense of starting and stopping an entire factory for the interruption of a Thanksgiving Thursday is often too great to warrant reopening for the balance of the week.

Christmas. The word *Christmas* is the compounded abbreviation of the old English words *Cristes Maesse,* meaning the "mass of Christ." In Latin it is called *Dies Natalis* and as such describes the day of the birth of Christ, and it is also called *Natalis Christi.* Christmas is observed annually by the Christian Church in memory of the birth of Jesus the anointed (Christ) in Bethlehem of Judea.[5] Eleven days after the birth (Epiphany) the Three Wise Men arrived in Bethlehem. In A.D. 566 the Second Council of Tours proclaimed the sanctity of the twelve-day period from Christmas to Epiphany as festive. The festival begins close to the winter solstice on the evening of December 24 and extends to Epiphany on January 6, the whole period being known as Christmastide. December 25 is the day of Incarnation and is known as

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[5] Matthew 2:1.

Christmas Day, or simply Christmas. The celebration of Christmas was forbidden by the Puritans, but it is now observed throughout Christendom by religious services.

In the custom of burning Yule logs during Christmas, we find the vestige of an ancient custom of welcoming the northward return of the sun at the winter solstice.

The various manifestations of Christmas observed in America have been brought from many countries of Europe: the Christmas tree from Germany; Santa Claus from Holland; the Christmas stockings from France; "Merry Christmas" from England, where it was shouted as a greeting from the windows to the passers-by in the street on Christmas morning. So also were the use of holly and mistletoe and the singing of carols borrowed from England.

Dionysius Exiguus is credited with having initiated the cycle of the Christian Era in A.D. 532 to run concurrently with the paschal cycle. He reckoned the start of the first A.D. year to have been Annunciation Day (March 25) and, consequently, December 25, A.D. 1 was designated as the date of Christ's birth.[6] This was later replaced by the Vulgar Christian reckoning introduced by Pope Gregory in 1582, starting the new year with January 1. According to modern calculations the birth of Christ is placed at December 25, 4 B.C.[7] In early Christian practice the new year began with the day of Incarnation, which fell on March 25. In papal reckoning Christmas was, however, counted as the beginning of the ecclesiastical year until the tenth century, as was the practice in the case of papal bulls until recent years.[8]

However, to eliminate confusion, Pius X by his *Motu Proprio* of December 8, 1910, decreed that beginning January 1, 1911, the papal bulls and other official documents be dated according to common custom, by the usual year which begins on January 1.[9]

Christmas, like other fixed dates, occurs on different days of the week from year to year.

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[6] N. H. Baynes, *Constantine the Great and the Christian Church*, pp. 97–100. Milford, London, 1929.

[7] Philip Alexander, *The Calendar: Its History, Structure and Improvement*, pp. 51 ff. Cambridge University Press, London, 1921.

[8] *The Catholic Encyclopaedia*, Vol. III, pp. 724–728. See "Christmas." Robert Appleton Company, New York, 1908.

[9] *The Catholic Encyclopaedia*, Vol. XIII, p. 151. See "The Apostolic Chancery." Robert Appleton Company, New York, 1912.

APPENDIX B

HOW TO DETERMINE THE DAY OF THE WEEK

Julian Calendar A.D. 1–2099 Gregorian Calendar A.D. 1582–2099

In Rome the Julian Calendar came to an end on Thursday, October 4, 1582. The following Friday marked the commencement of the Gregorian Calendar, and was dated October 15, 1582. In England and in its colonies, however, the Julian Calendar terminated on Wednesday, September 2, 1752. The Gregorian Calendar began the following day, Thursday, but was dated September 14, 1752. This was done to harmonize the civil year with the solar year and to perpetuate the continuity of the week. Consequently, in both calendars the days of the week coincide, the months concur in part, while the dates are always different.

Example: The Soviet Republic was proclaimed by the Military Revolutionary Committee in 1917 on October 25, Julian Calendar, and on November 7, Gregorian. What was the corresponding day of the week for both dates?

Directions: In computing the days of the week, we have to consider four factors: date, month, year, and century. Take October 25, 1917. The date, 25, represents the date factor. From Table A, for common year 1917, for October, we get 2 for the month factor. From Table B, for 17, the last two numbers of the year, we get 0 for the year factor. From Table C, for 19, the first two numbers of the year, we get 4 for the century factor for the Julian Calendar. Add these factors as follows:

Date factor	25
Month factor	2
Year factor	0
Century factor	4
Total	31

Divide this total, 31, by 7. 3 remains. Turn to Table D. We find that this remainder factor, 3, corresponds to Wednesday. Thus, October 25, 1917, was Wednesday by the Julian Calendar.

TABLE A

		January	February	March	April	May	June	July	August	September	October	November	December
Month	Common Year	2	5	5	1	3	6	1	4	0	2	5	0
Factor	Leap Year	1	4	5	1	3	6	1	4	0	2	5	0

TABLE B

00	1	2	3		**4**	5
6	7		**8**	9	10	11
	12	13	14	15		**16**
17	18	19		**20**	21	22
23		**24**	25	26	27	
28	29	30	31		**32**	33
34	35		**36**	37	38	39
	40	41	42	43		**44**
45	46	47		**48**	49	50
51		**52**	53	54	55	
56	57	58	59		**60**	61
62	63		**64**	65	66	67
	68	69	70	71		**72**
73	74	75		**76**	77	78
79		**80**	81	82	83	
84	85	86	87		**88**	89
90	91		**92**	93	94	95
	96	97	98	99		
Year Factor	0	1	2	3	4	5	6

TABLE C

Julian	2	1	0	6	5	4	3
	9	8	7	13	12	11	10
	16	15	14	20	19	18	17
Gregorian					16	15	
	18		17		20	19	
Century Factor	0	1	2	3	4	5	6

TABLE D

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Remainder Factor	0	1	2	3	4	5	6

Note: The years 1700, 1800, and 1900 were leap years according to the Julian Calendar, but common years according to the Gregorian. The figures in bold type in Table B indicate the last two numbers of the leap years.

The above tables are adapted from Francis Rolt-Wheeler, *The Fact Book*, p. 13. The Current Literature Publishing Company, New York, 1911.

Similar data for November 7, 1917, Gregorian Calendar:

Date factor	7
Month factor	5
Year factor	0
Century factor	5
Total	17

Divide this number by 7. 3 remains. This remainder factor, 3, in Table D gives us Wednesday for November 17, 1917, by the Gregorian Calendar.

If the total of all factors is less than 7, it should be regarded as the remainder factor and used to determine the day of the week.

APPENDIX C

A SELECTED LIST OF REFERENCES

The literature on the calendar is indeed extensive. Limitations of space will permit the inclusion of but a few, selected as excellent source material for further study.

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